

Stratifikace a míchání jezer

- **Typy stratifikace nádrží** (opakování, rekapitulace)
- **Geografická variabilita** faktorů určujících hydrodynamiku a produktivitu
- **Dimiktická jezera**
- **Teplá monomiktická jezera**
- Srovnání limnologie jezer Bajkal vs. Tanganika a Malawi
- **Meromixie**
- **Atelomixie**
- **Stratifikace a produkce**

Typy stratifikace nádrží:

(opakování, rekapitulace)

amiktické

studené monomiktické

studené polymiktické

dimiktické

teplé monomiktické

teplé polymiktické

Geografická variabilita:

amiktické – trvale zamrzlé

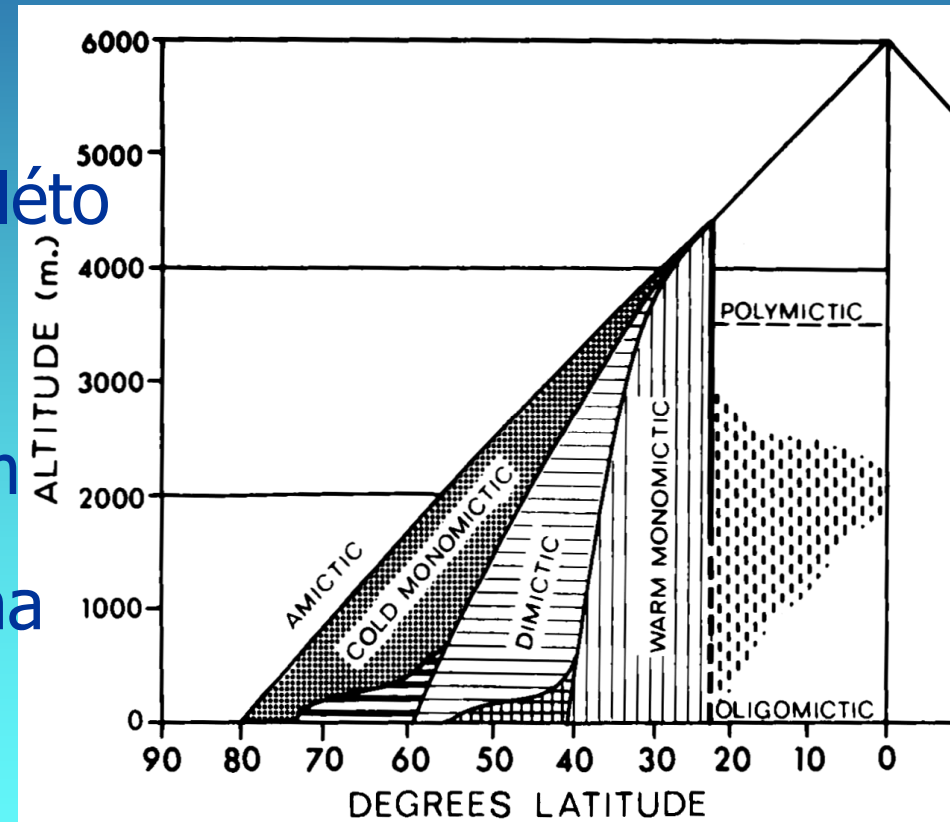
studené monomiktické – 1× / léto

studené polymiktické

dimiktické – 2× / jaro / podzim

teplé monomiktické – 1× / zima

teplé polymiktické



tepelný příkon @ zem. šíř. / nadm. výš.

Geografická variabilita a morfologie jezer:

amiktické – trvale zamrzlé

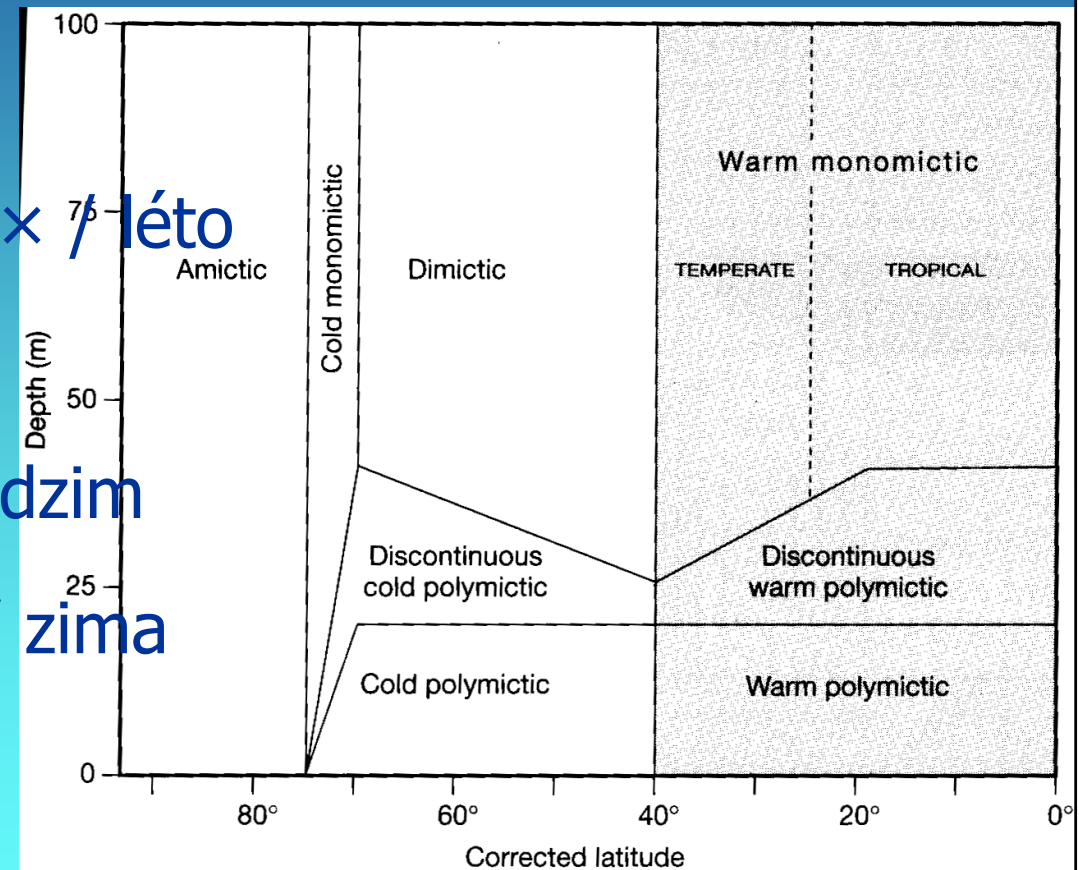
studené monomiktické – 1× / léto

studené polymiktické

dimiktické – 2× / jaro / podzim

teplé monomiktické – 1× / zima

teplé polymiktické



tepelný příkon @ zem. šíř. / nadm. výš. + morfologie

Stratifikovaná jezera:

<http://www.ilec.or.jp/database/database.html>

amiktická – inverzní (pod ledem)

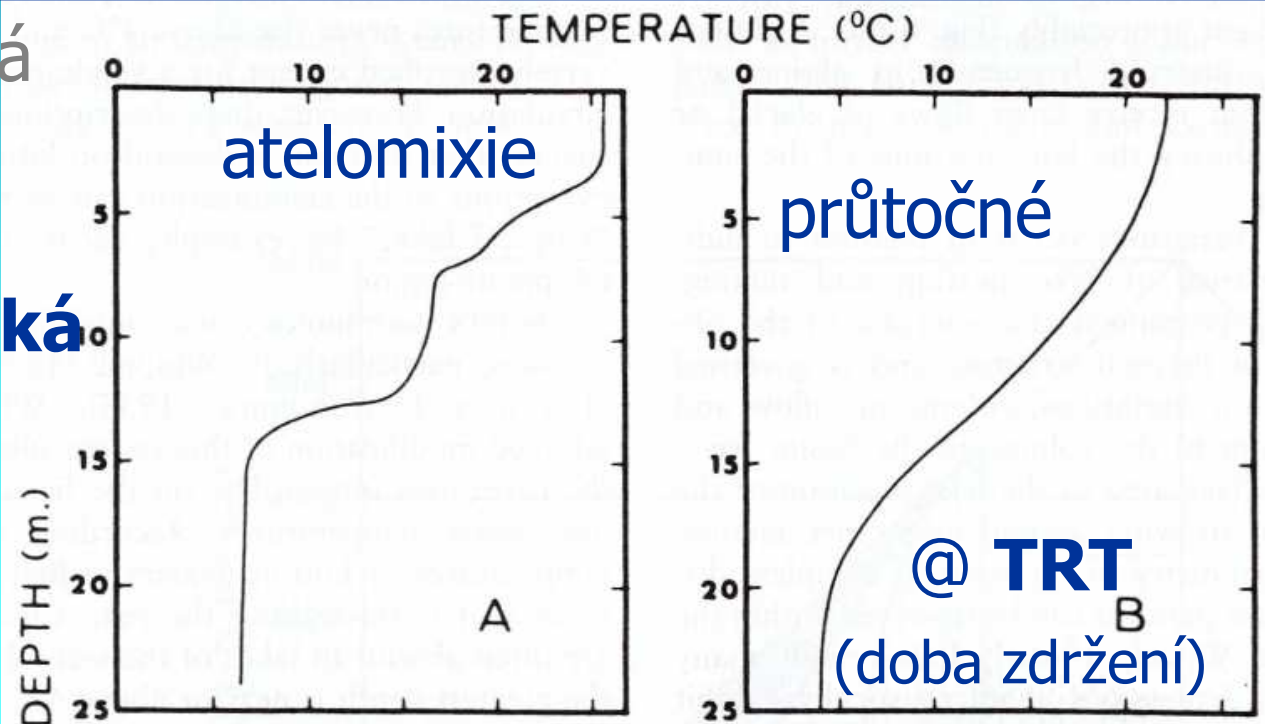
studená monomiktická – inverzní (pod ledem)

studená polymiktická

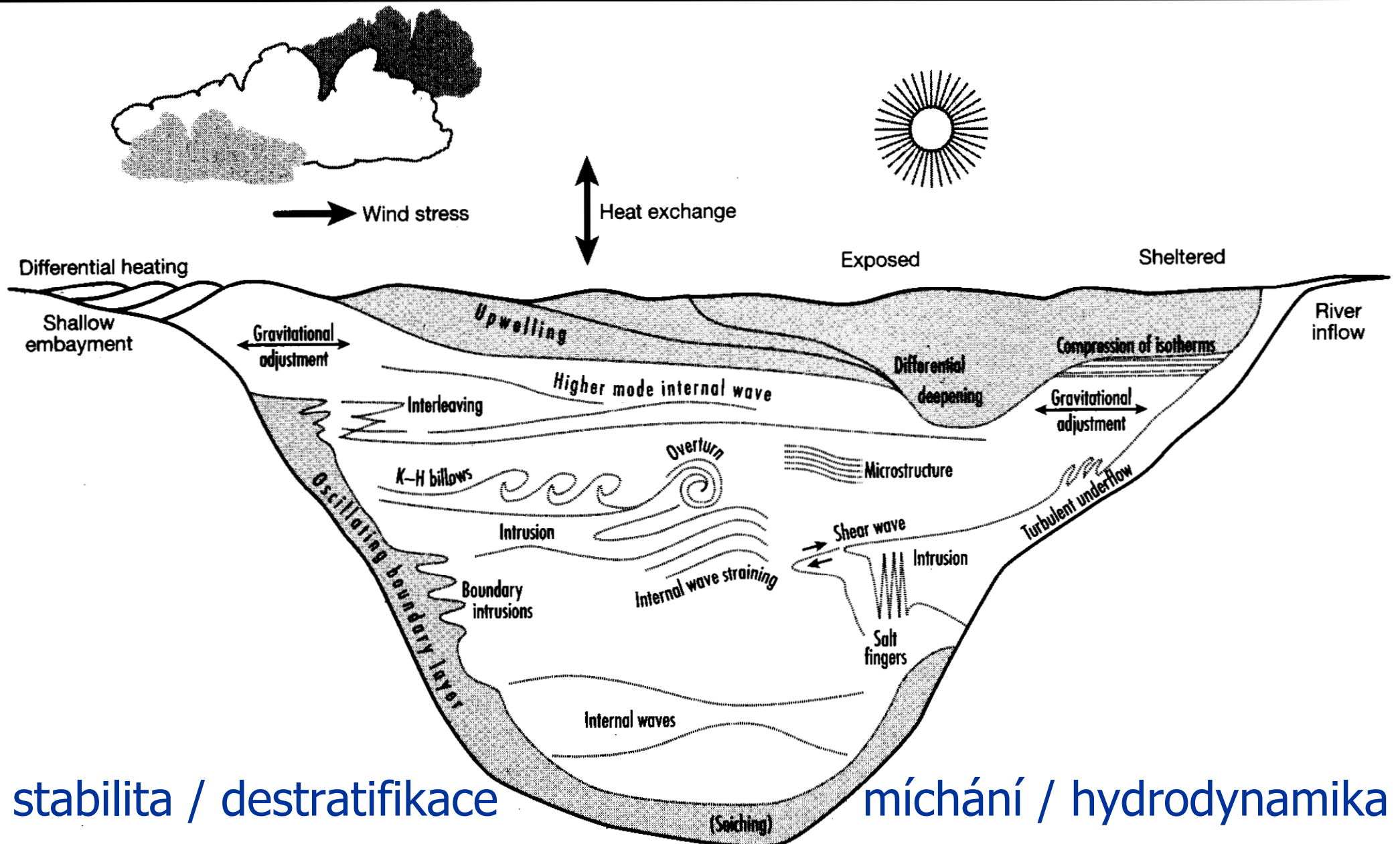
dimiktická

teplá monomiktická

teplá polymiktická



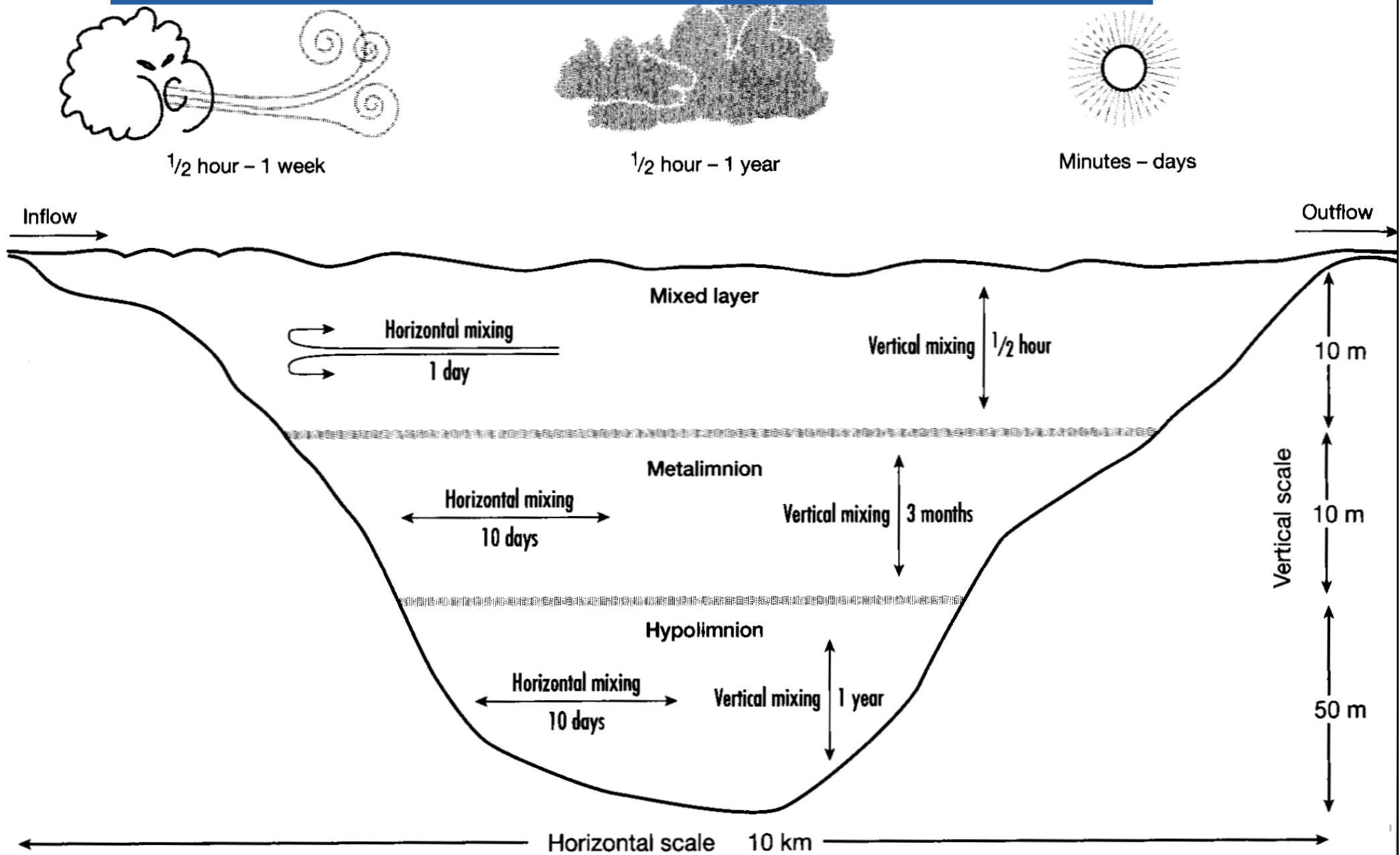
Stabilita stratifikace / pohyby vody: (opakování, rekapitulace)



stabilita / destratifikace

míchání / hydrodynamika

Stabilita stratifikace / pohyby vody: (opakování, rekapitulace)

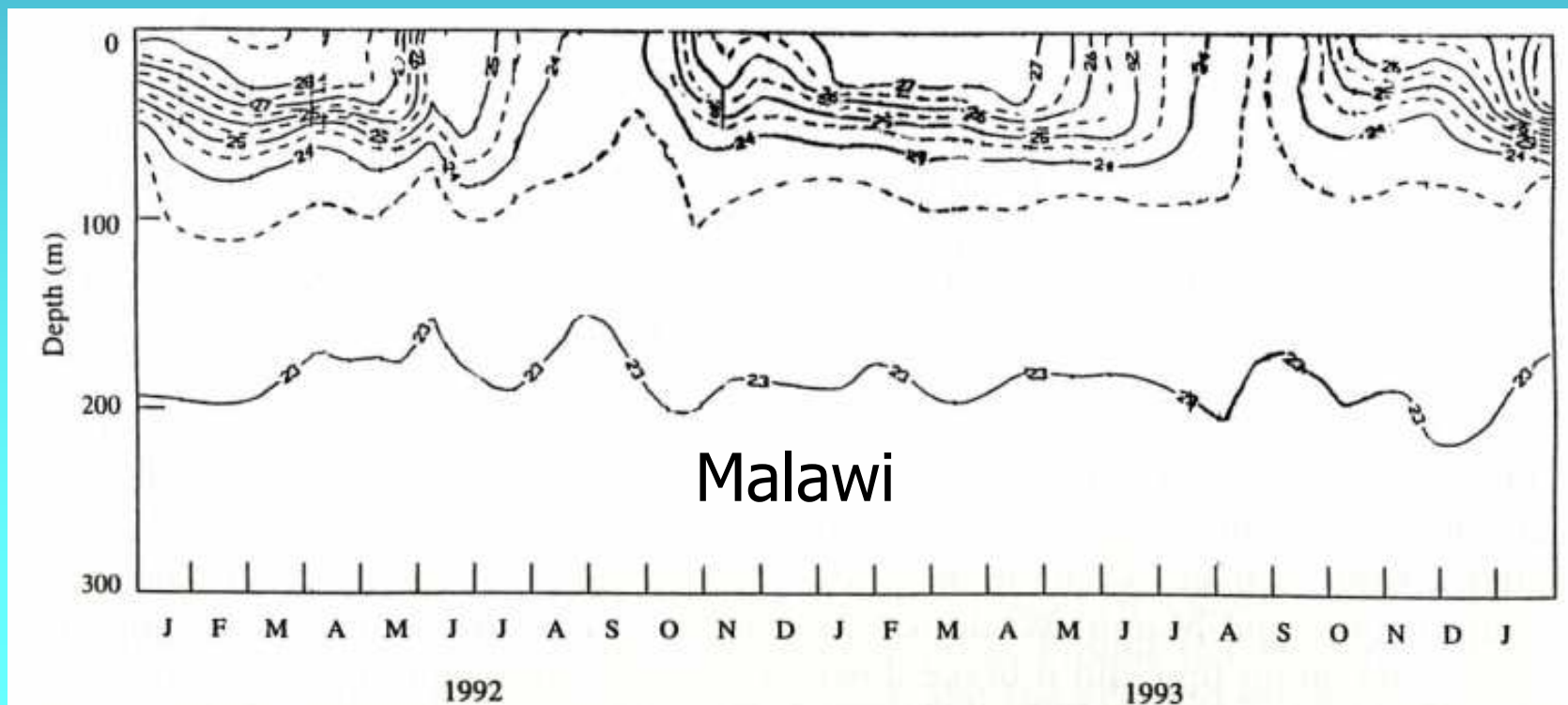


Typy stratifikace nádrží: (opakování, rekapitulace)

holomiktické – epilimnion / metalimnion / hypolimnion

meromiktické – mixolimnion / monimolimnion

– chemoklina, haloklina, **tepelná stabilita!**



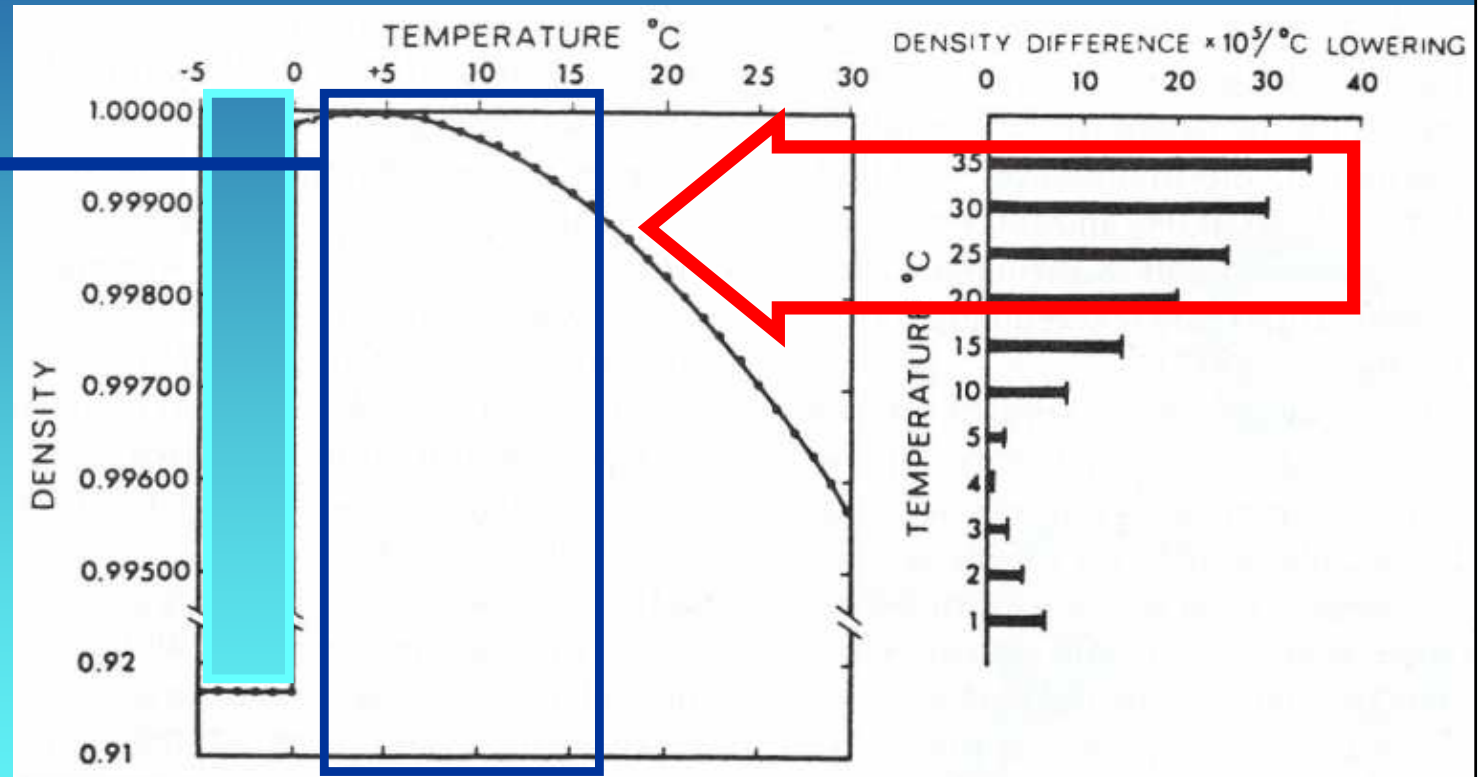
Stratifikace a míchání:

(opakování, rekapitulace)

holomixie

meromixie,

atelomixie



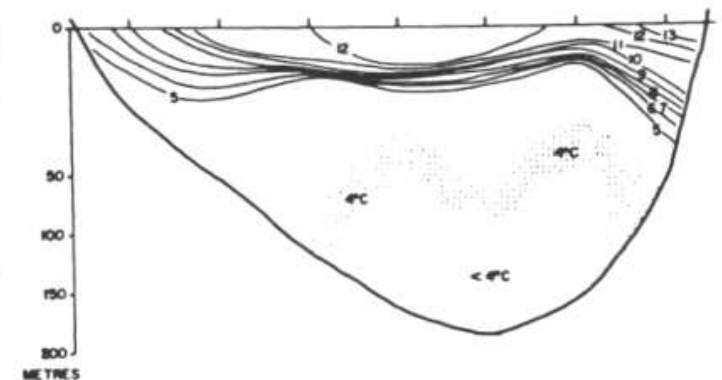
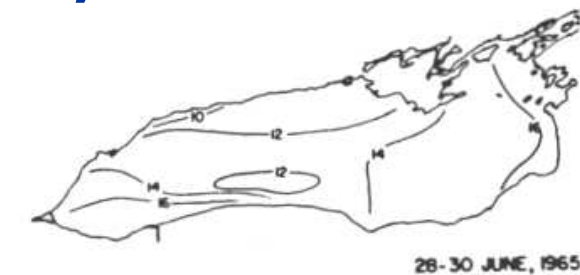
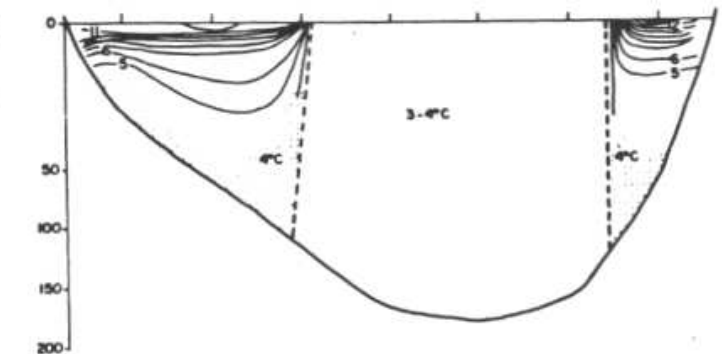
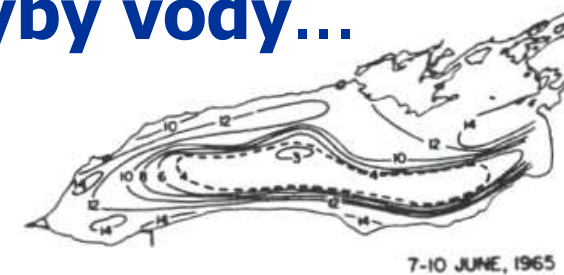
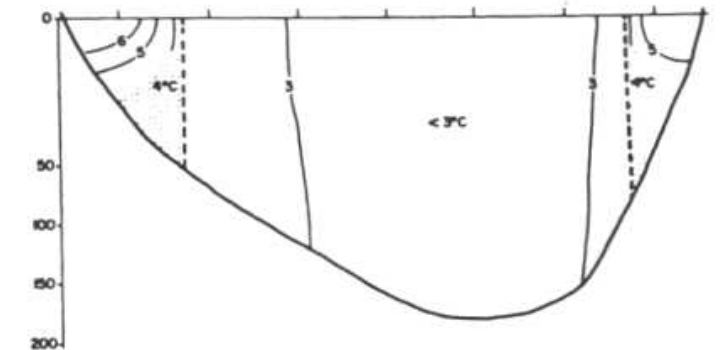
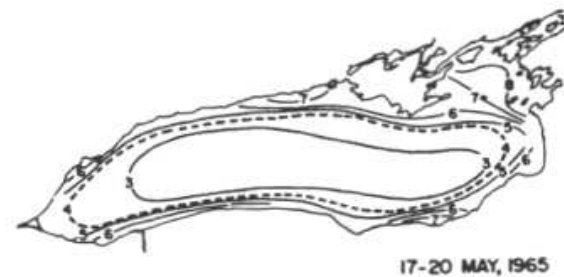
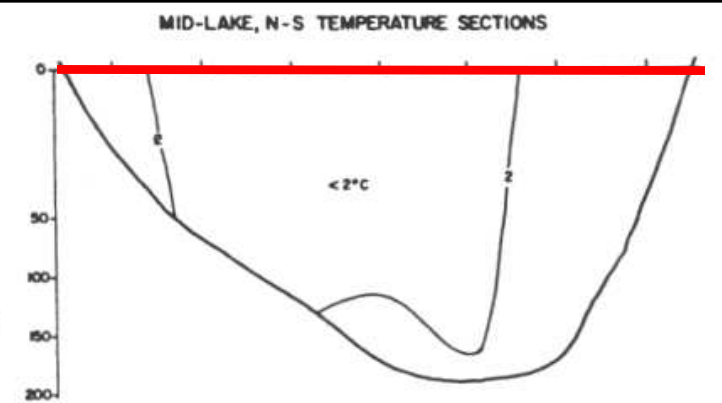
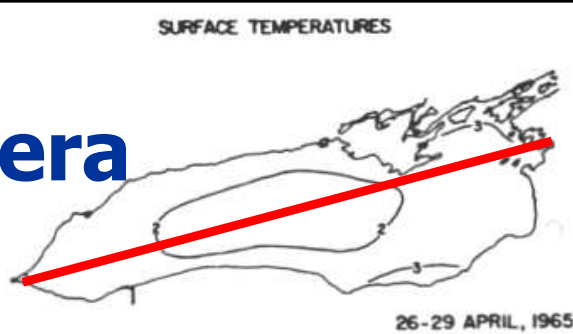
stratifikace @ **hustota + teplota + salinita + tepelná en.**
míchání @ **kinetická en. + hydraulika + morfologie**
+ výměna tepla

Dimiktická jezera

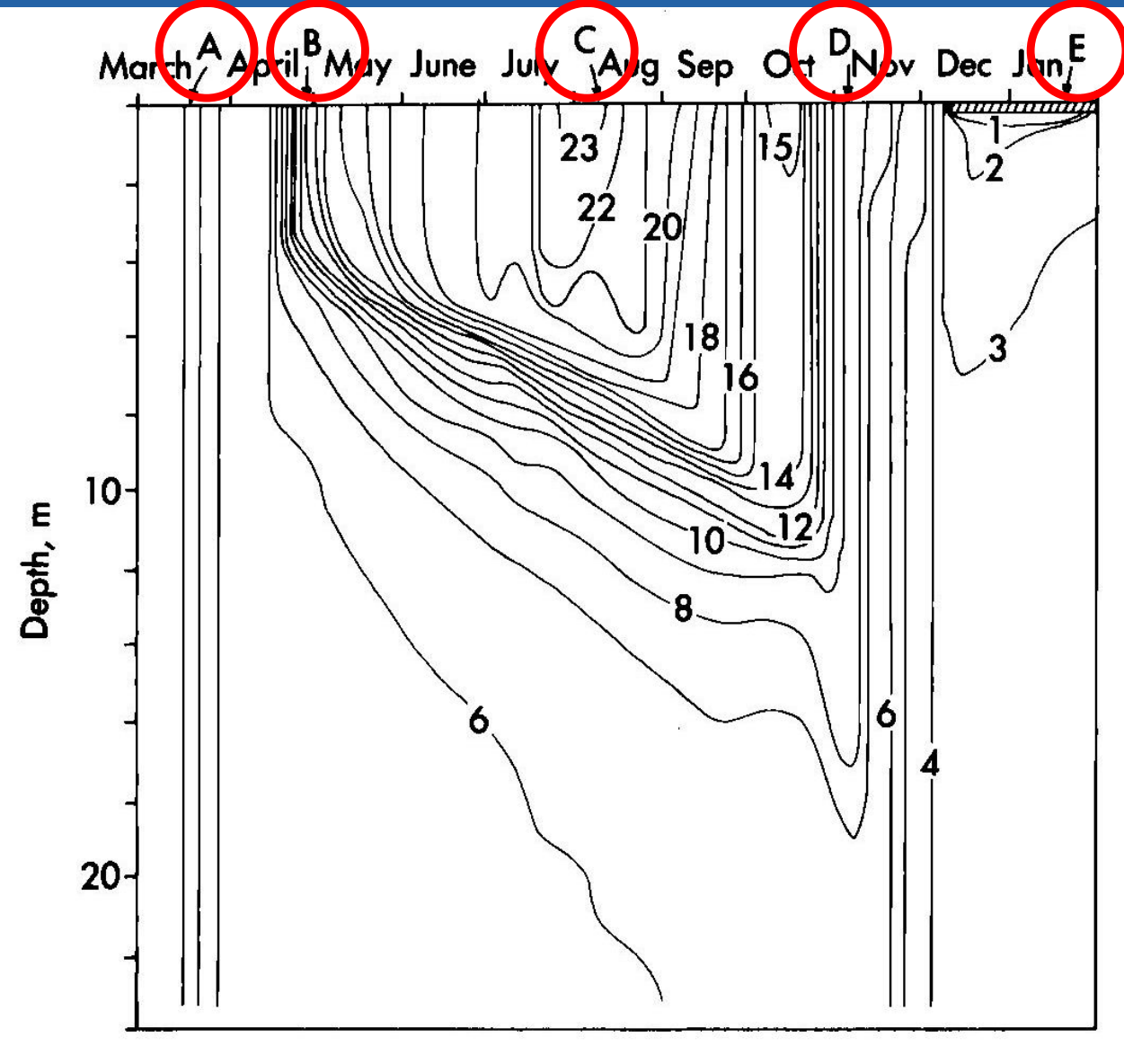
Ustavení letní stratifikace trvá téměř 2 měsíce !

tepelný příkon, morfologie, hydraulické pohyby vody...

The Great Lakes, Ontario

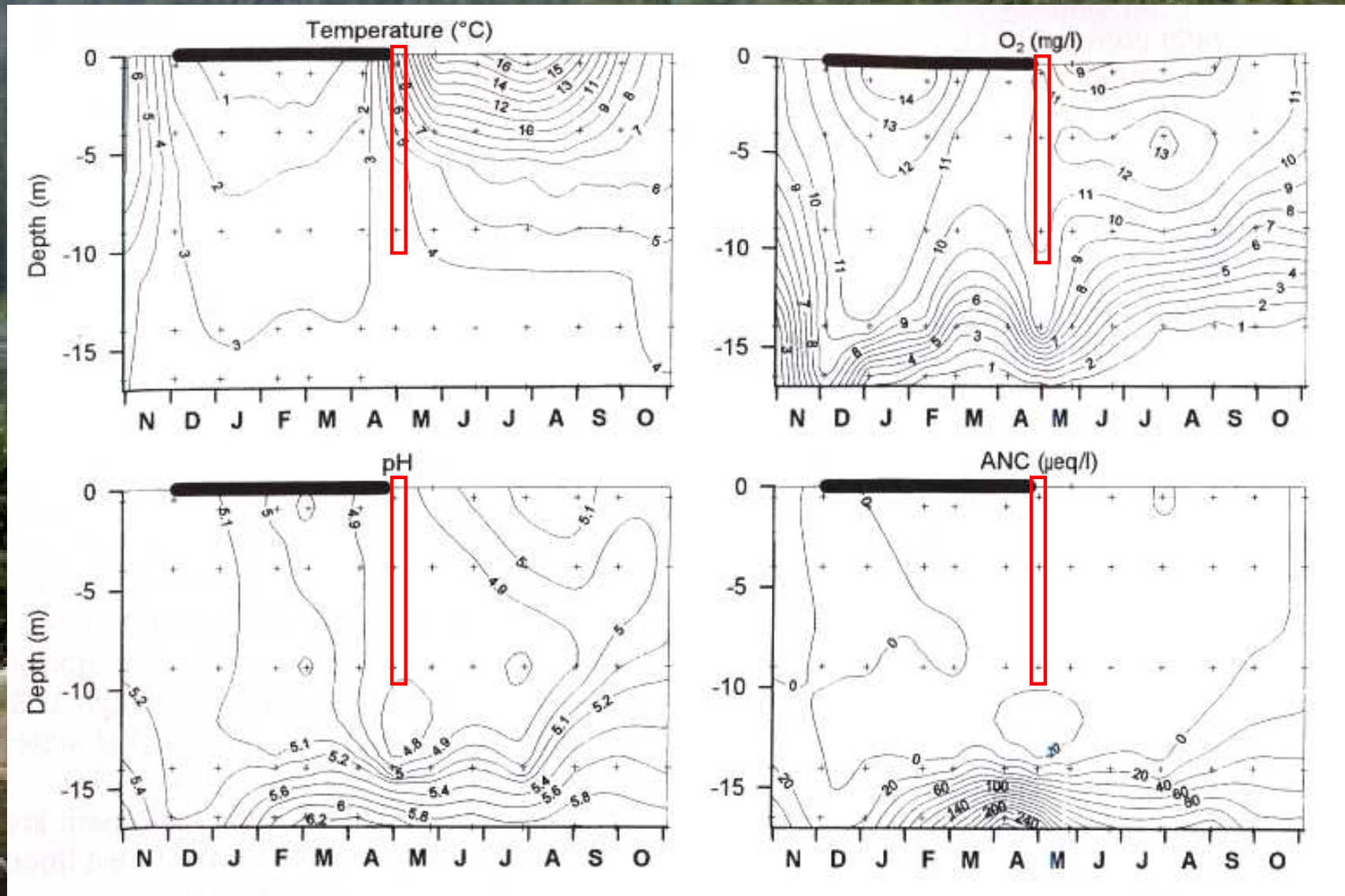


Dimiktická jezera



Dimiktická jezera – neúplné míchání

Plešné jezero

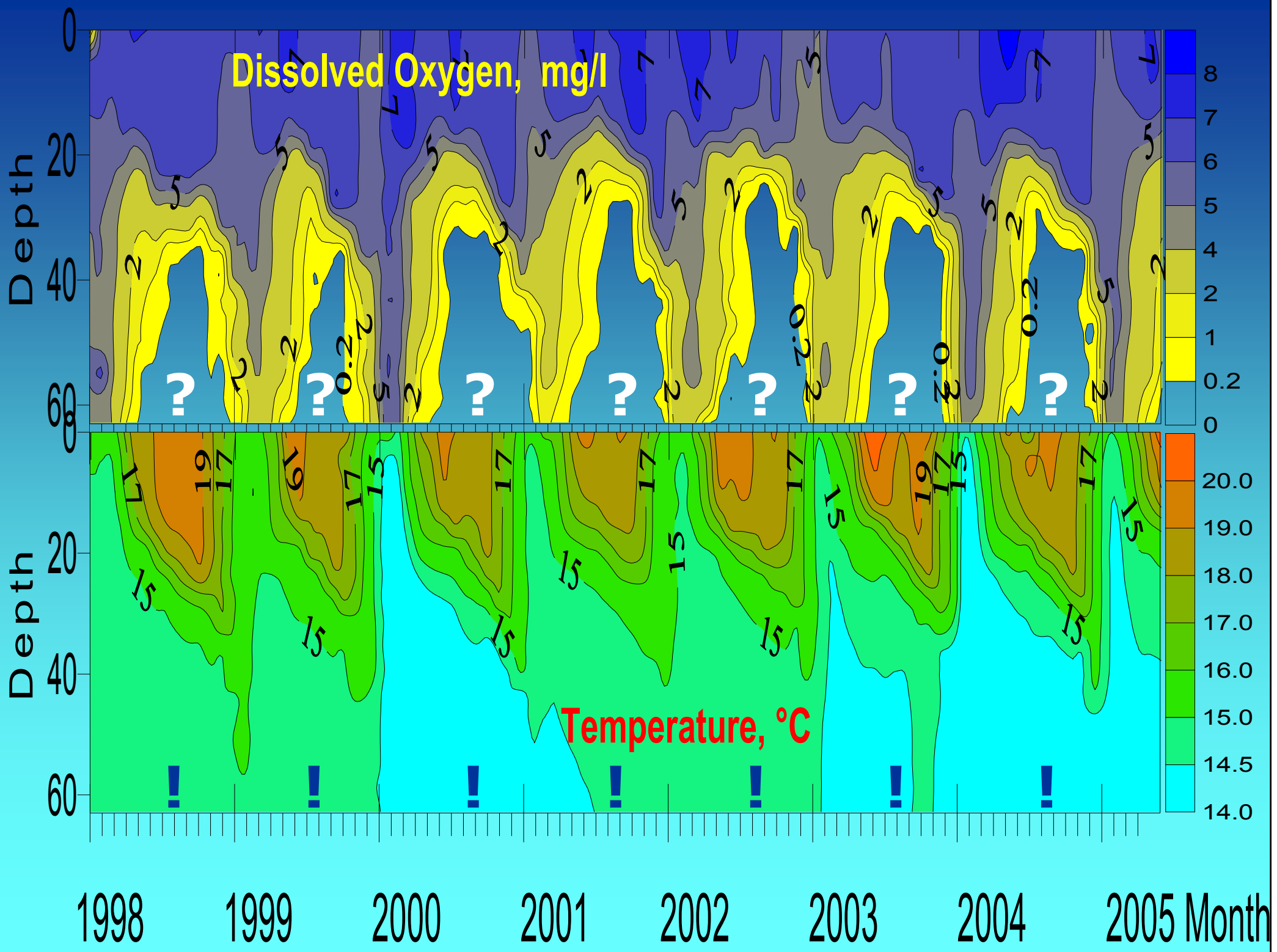


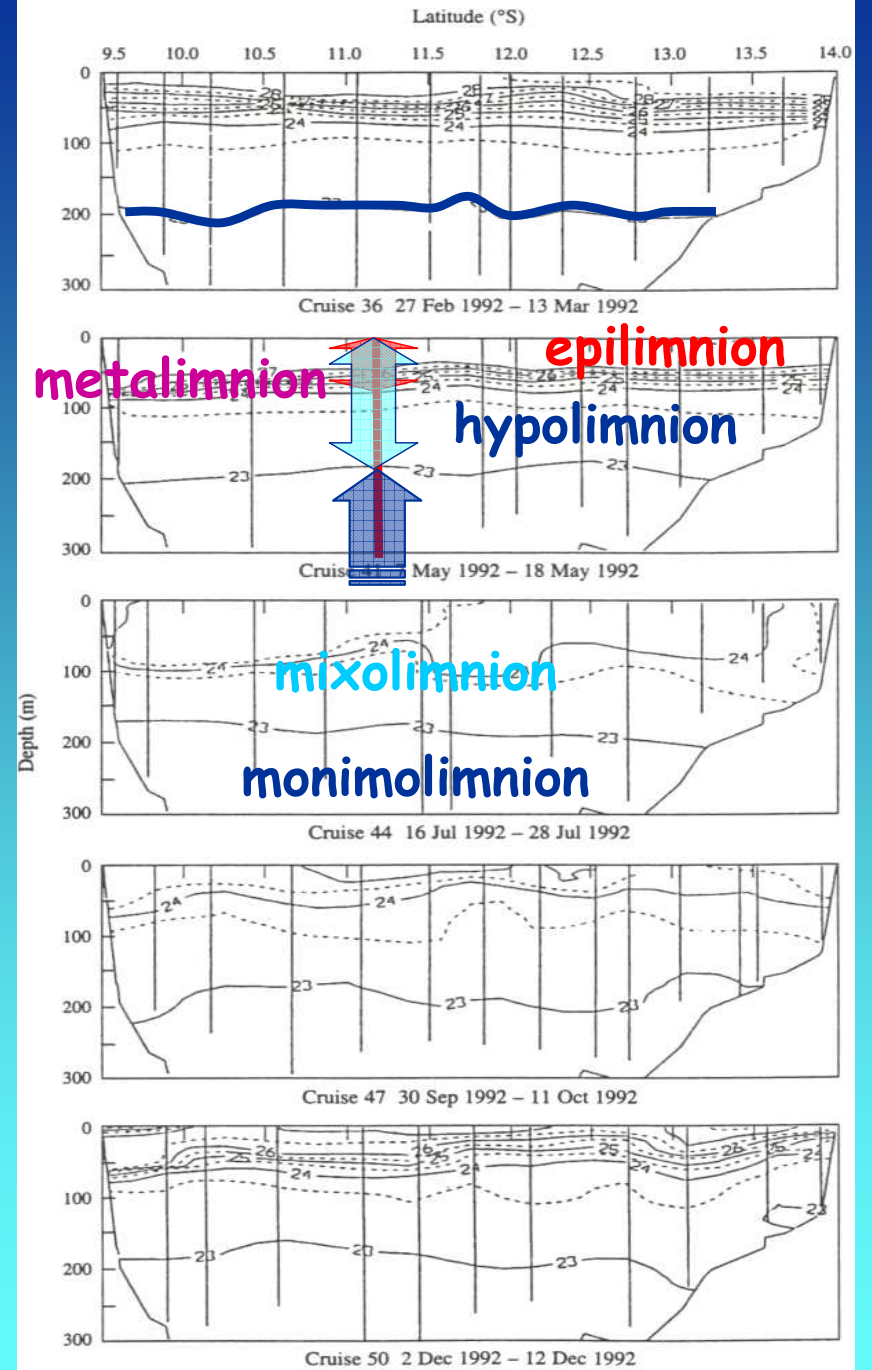
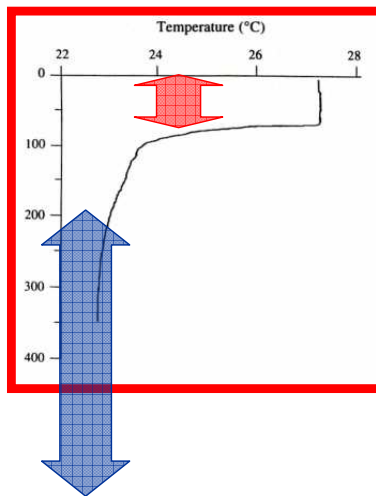
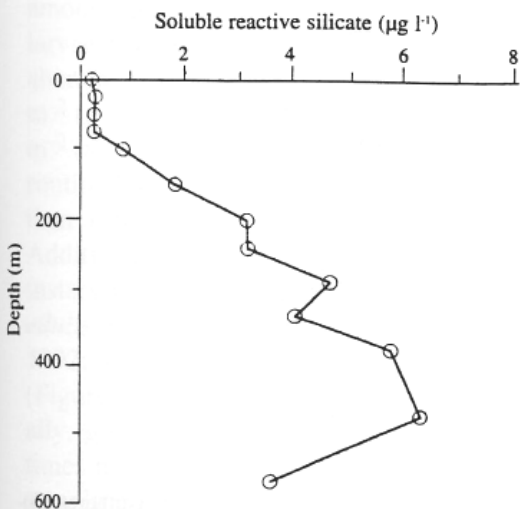
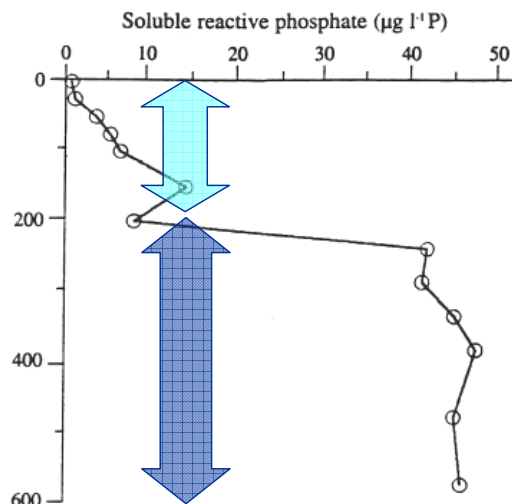
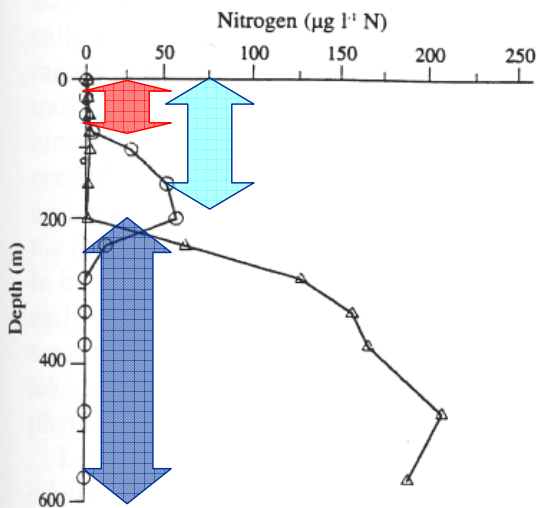
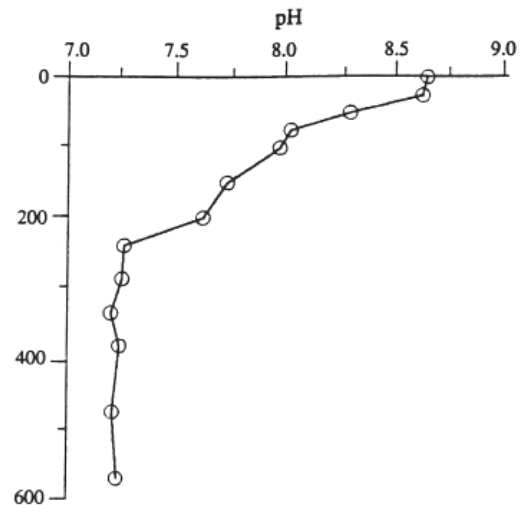
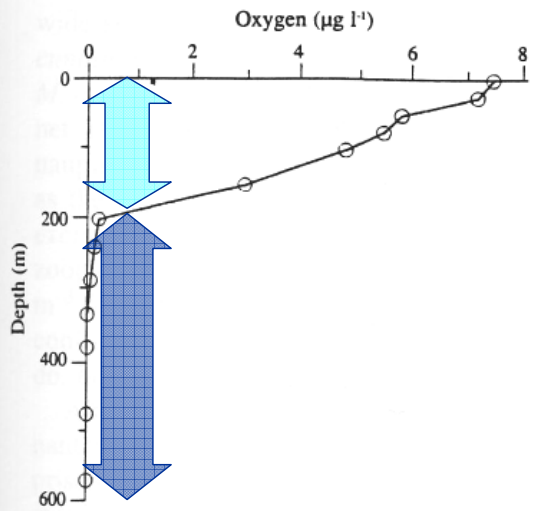
Teplé monomiktické jezero

Alchichica, Mexico

(19° s.š.; 2345 m n.m.; max. hl. 63 m; slané)







Ve stratifikaci jezer existují geografické rozdíly!

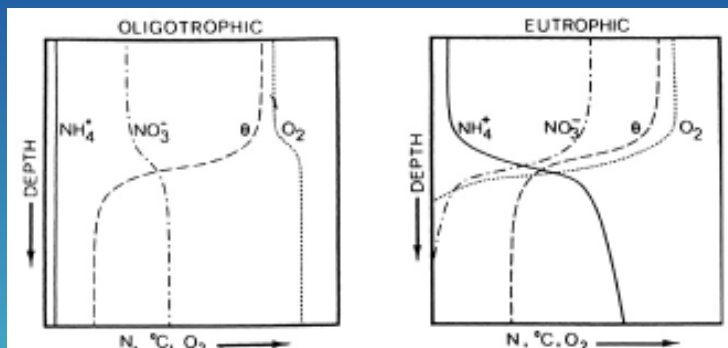


FIGURE 12-4 Generalized vertical distribution of ammonia and nitrate nitrogen in stratified lakes of very low and high productivity.

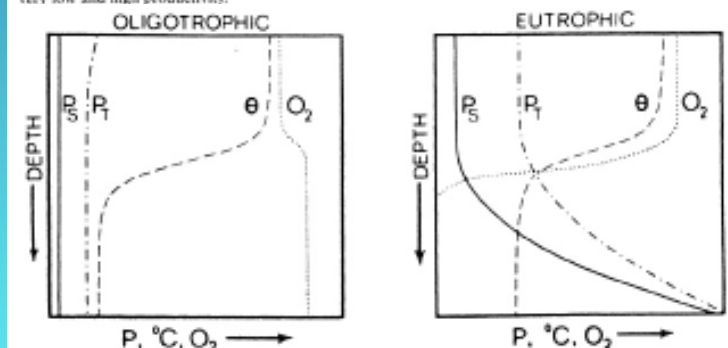


FIGURE 13-1 Generalized vertical distribution of soluble (P_S) and total (P_T) phosphorus in stratified lakes of very low (oligotrophic) and of high (eutrophic) productivity.

Anoxické hypolimnion mají

- eutrofní dimiktická jezera,
- ale také oligotrofní teplá monomiktická jezera!

Ve stratifikaci jezer existují geografické rozdíly!

Oligotorofní, dimiktické/holomiktické

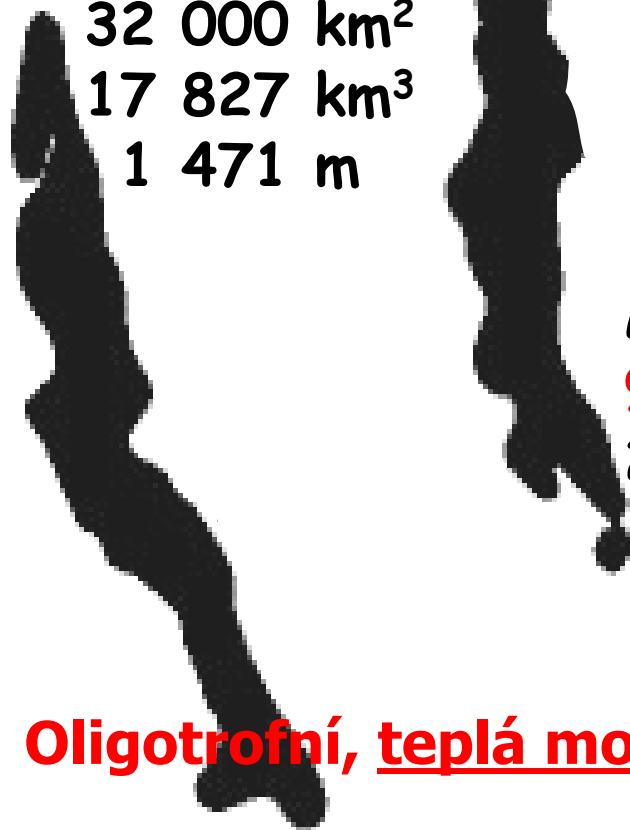
Tanganika

3,5-9° j.š.

32 000 km²

17 827 km³

1 471 m



Malawi

9,5-14° j.š.

22 490 km²

6 140 km³

706 m



Bajkal

51-56° s.š.

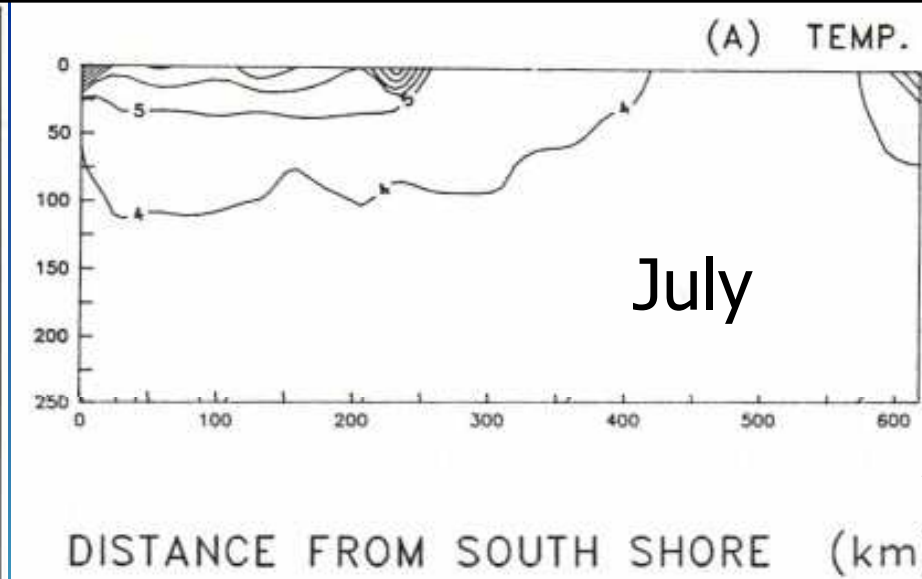
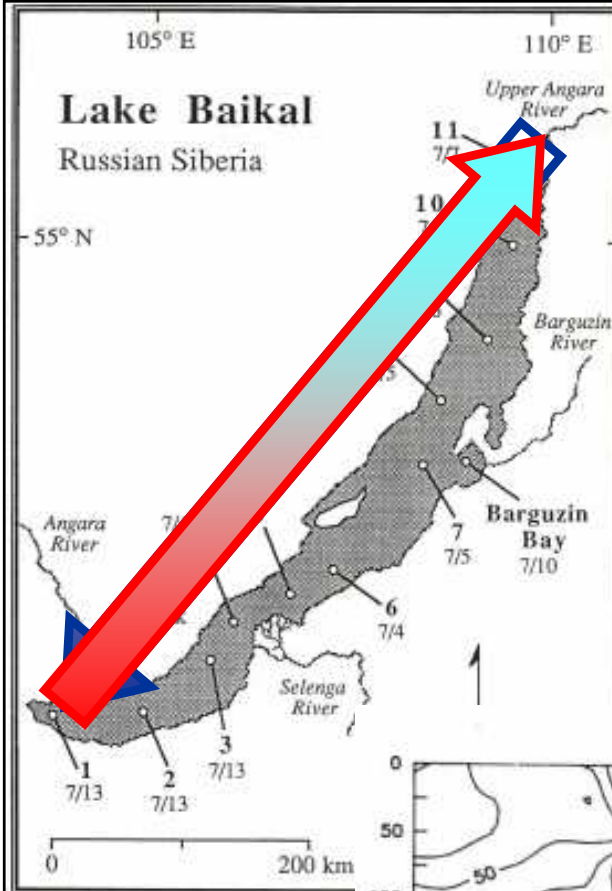
31 500 km²

23 600 km³

1 637 m

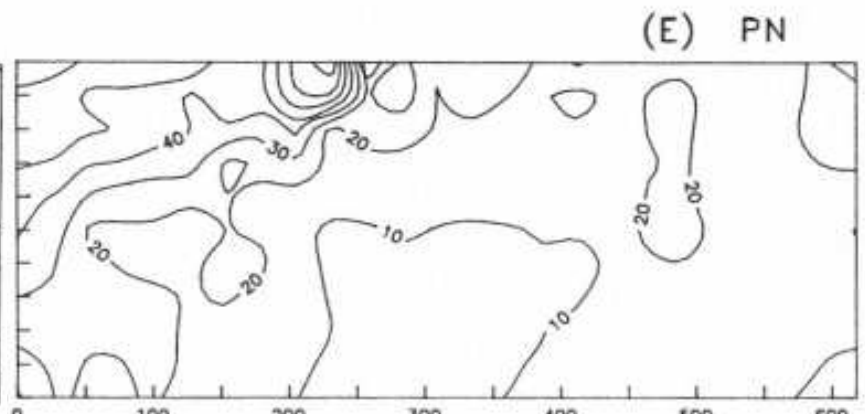
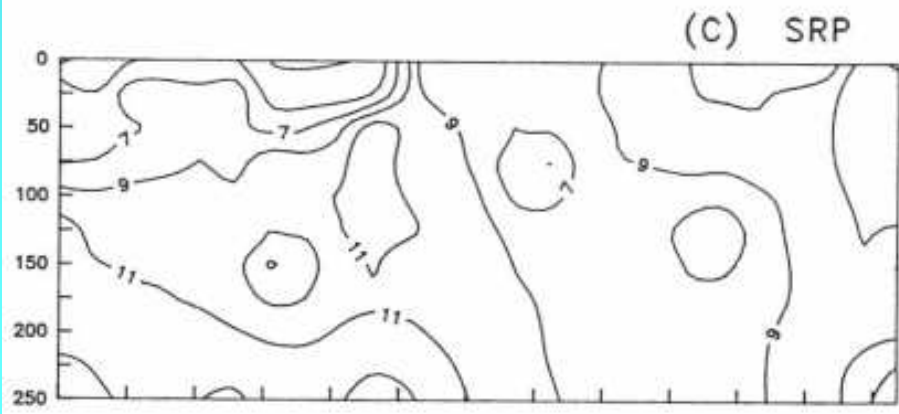
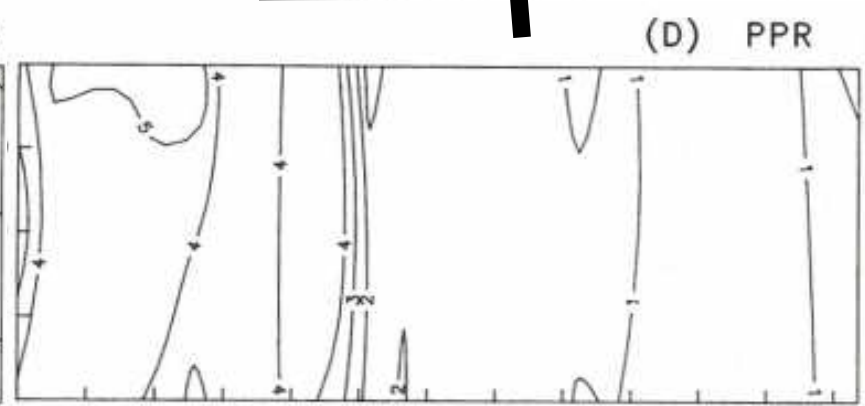
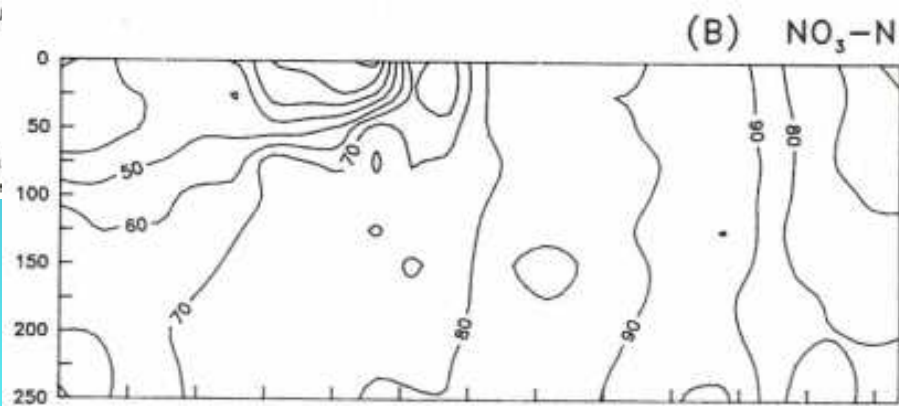


Oligotrofní, teplá monomiktická/meromiktická



jediný odtok
Angara

Selenga
=50-60%



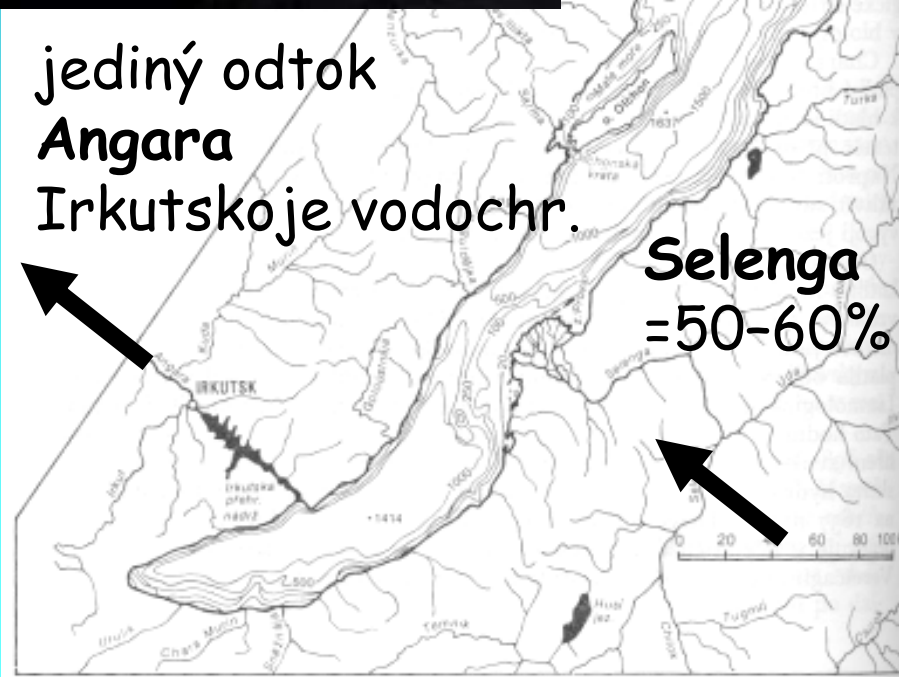


TRT = ~330 r. pro celý Bajkal
(~60 r. pro jižní Bajkal)

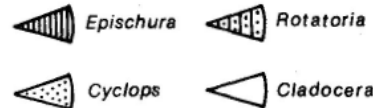
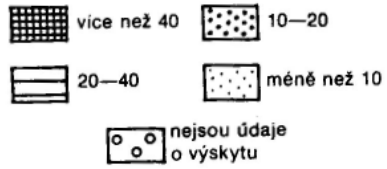
pro „hlubinnou vodu“ jen 7–19 r.!
(dotace O_2 : $2,3 \text{ mol m}^{-2} \text{ r.}^{-1}$)

jediný odtok
Angara
Irkutskoje vodochr.

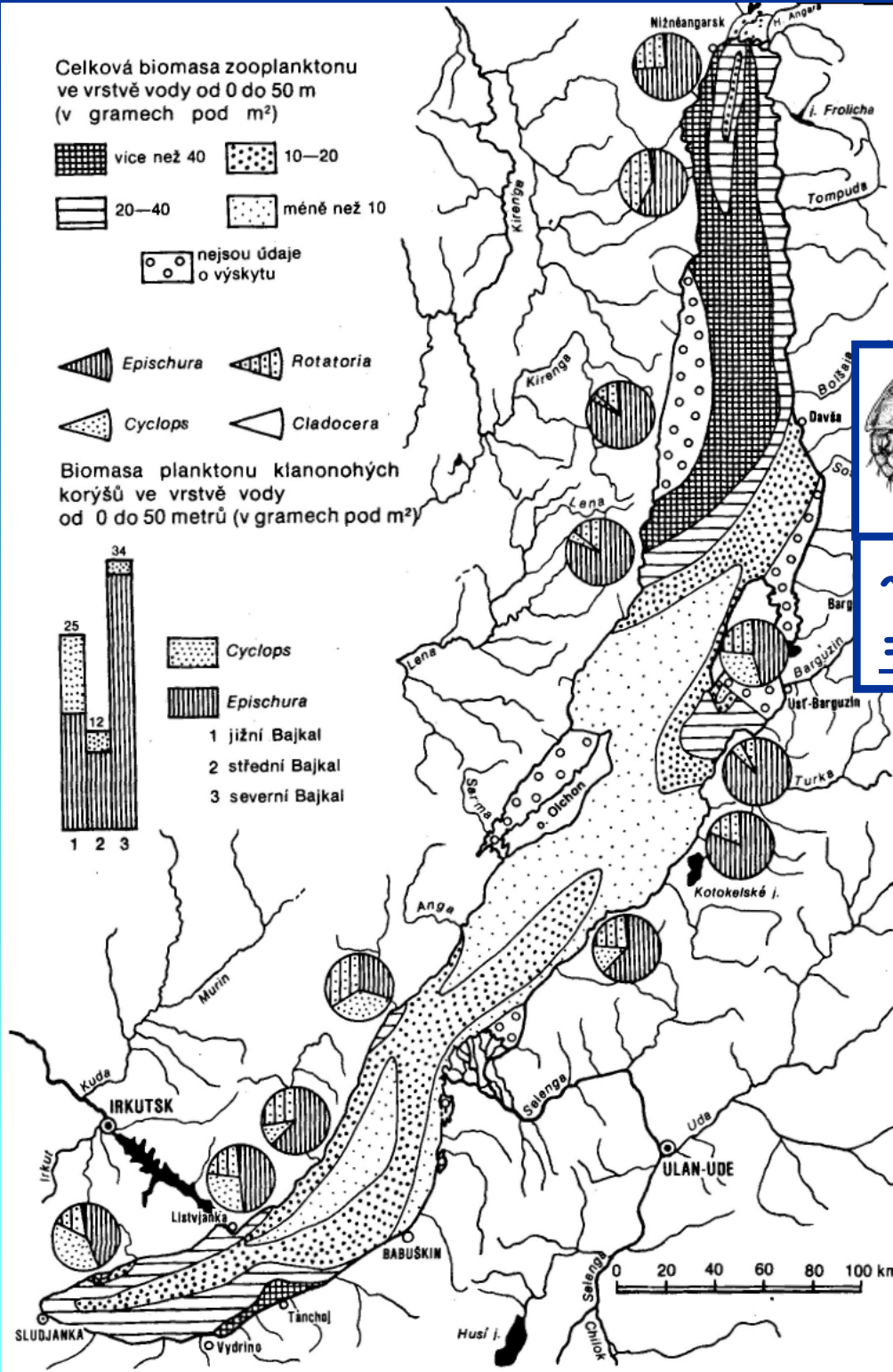
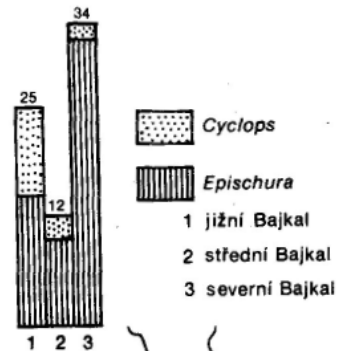
Selenga
=50-60%



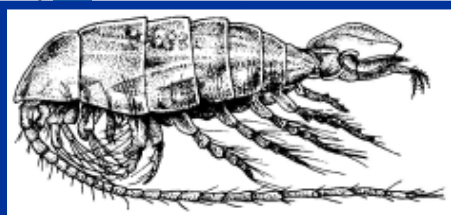
Celková biomasa zooplanktonu ve vrstvě vody od 0 do 50 m (v gramech pod m²)



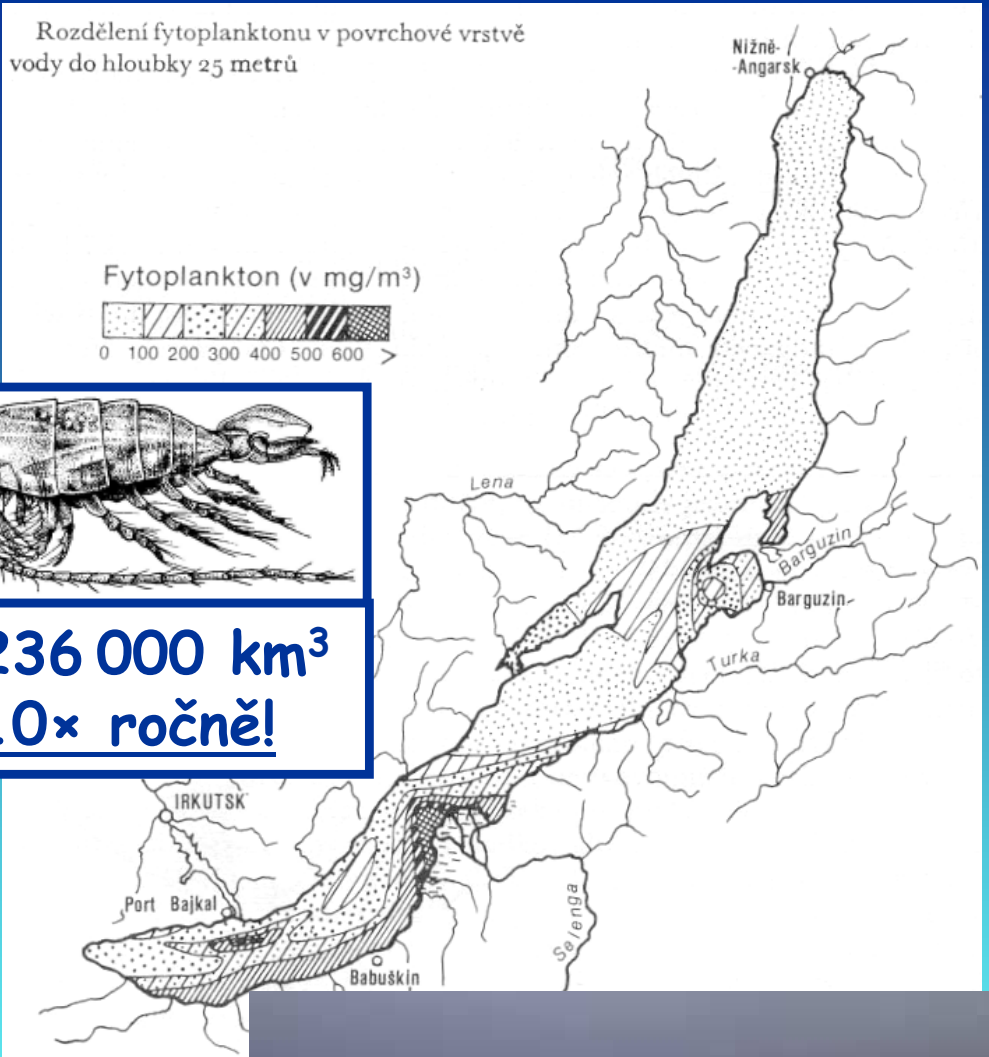
Biomasa planktonu klanonohých koryšů ve vrstvě vody od 0 do 50 metrů (v gramech pod m²)

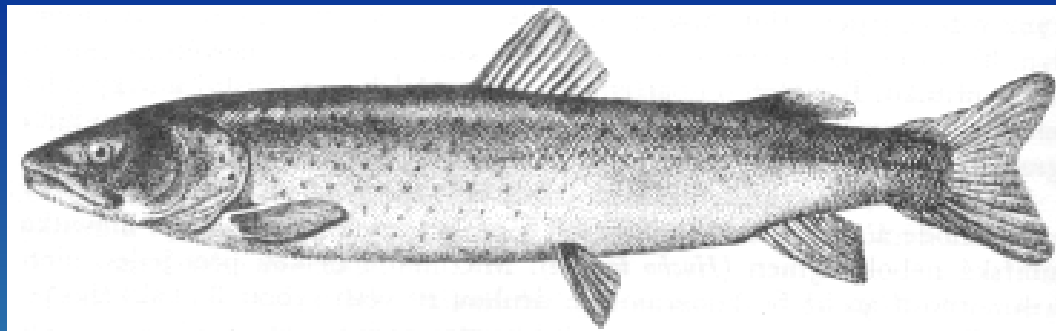


Rozdělení fytoplanktonu v povrchové vrstvě vody do hloubky 25 metrů

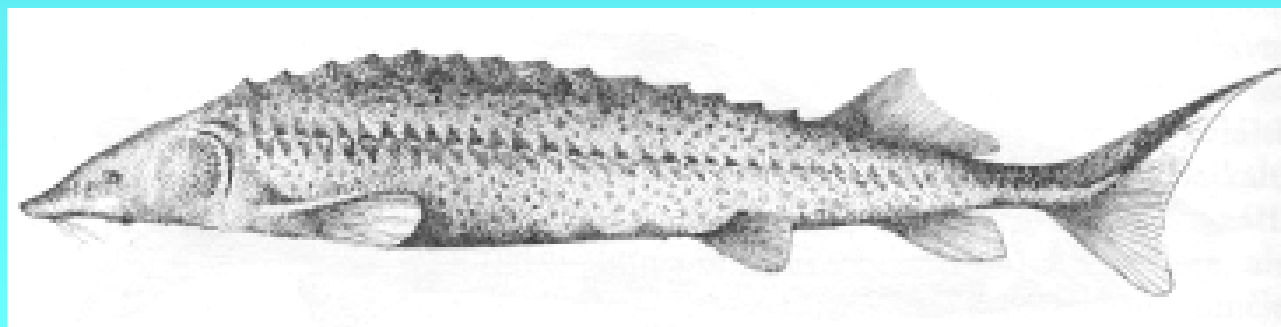
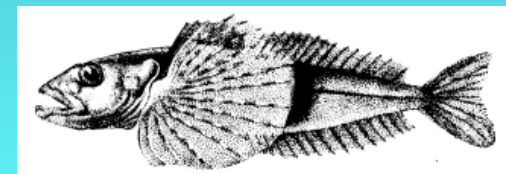


**~236 000 km³
= 10× ročně!**





golomjanky
 $\sim 2/3$ celkové
biomasy ryb!



Teplé monomiktické jezero

Tanganika, Afrika

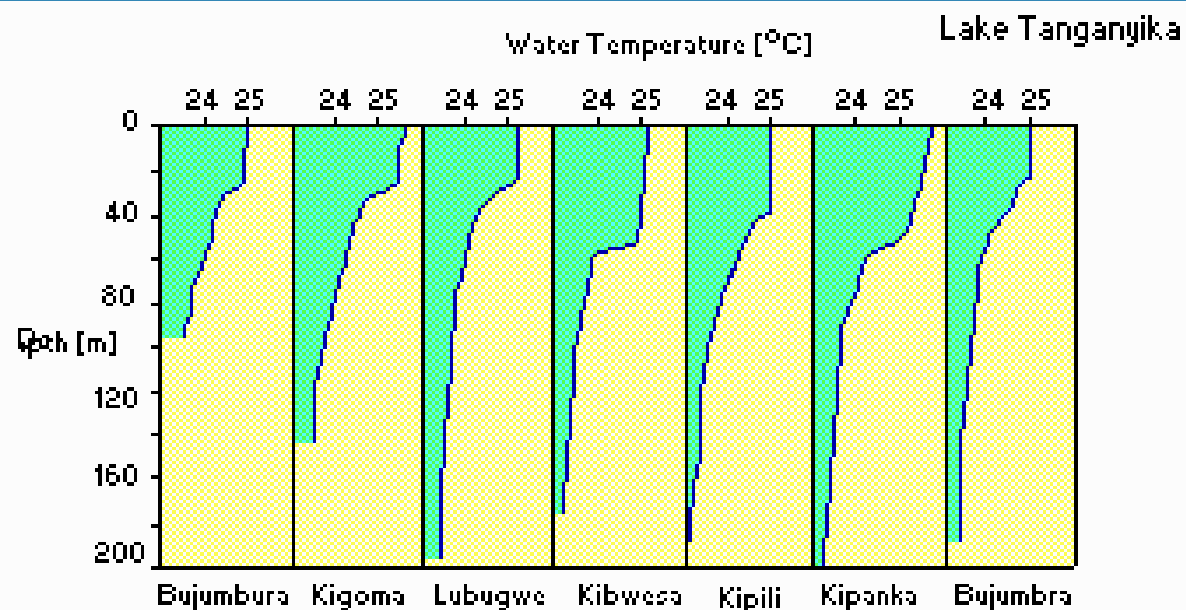
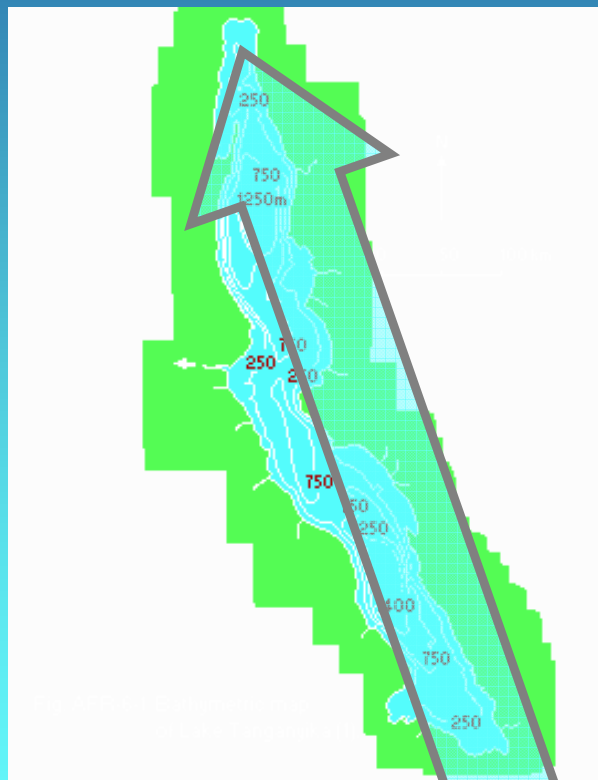
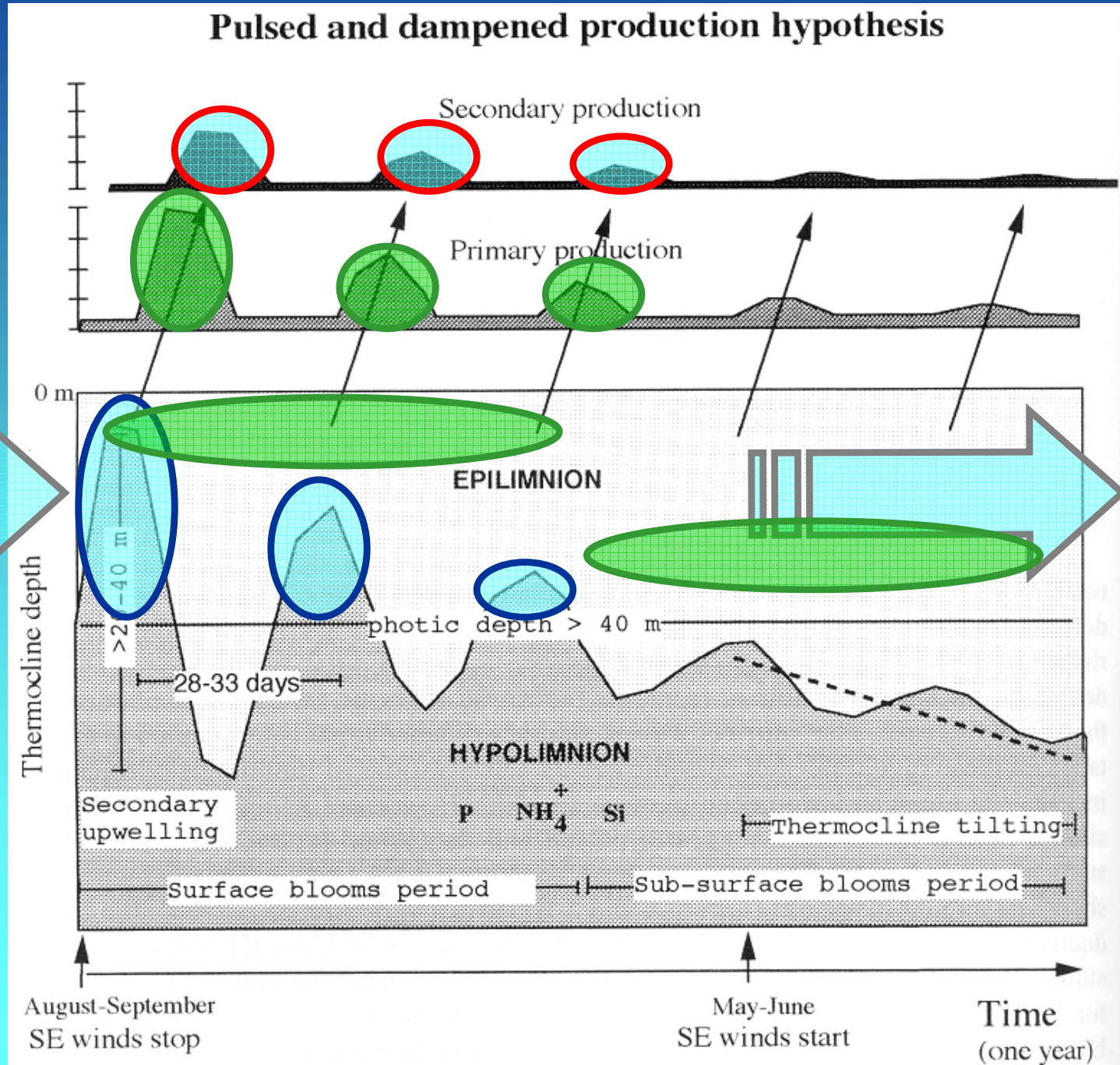
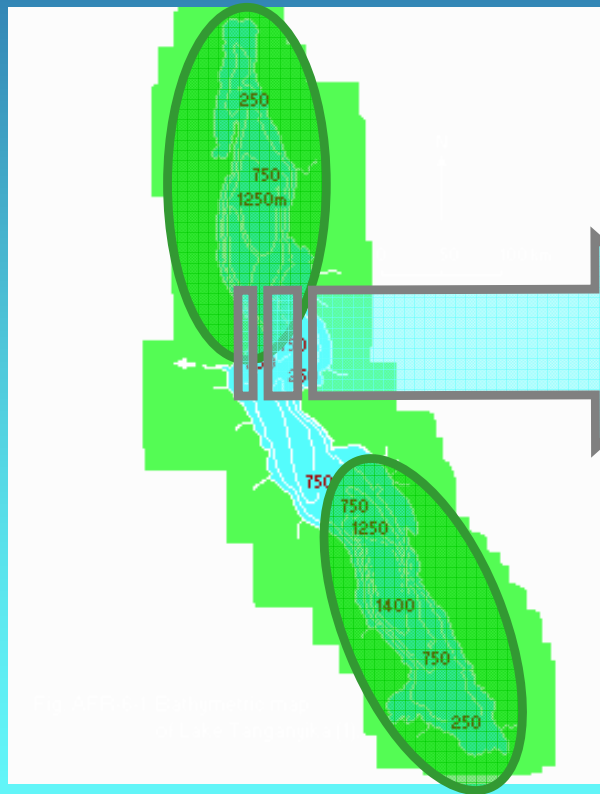


Fig. AFR-6-2 Vertical distribution of water tempertaure [°C] at 7 stations around the lake, Oct.-Nov. 1975 (place names refer to the nearest port) (4).

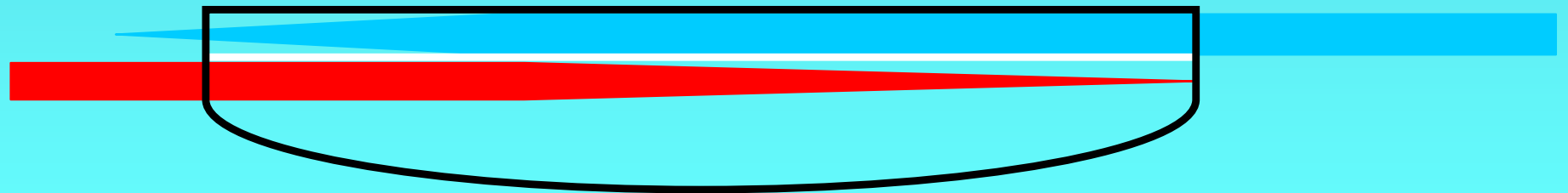
Teplé monomiktické jezero – interní séše

Tanganika,

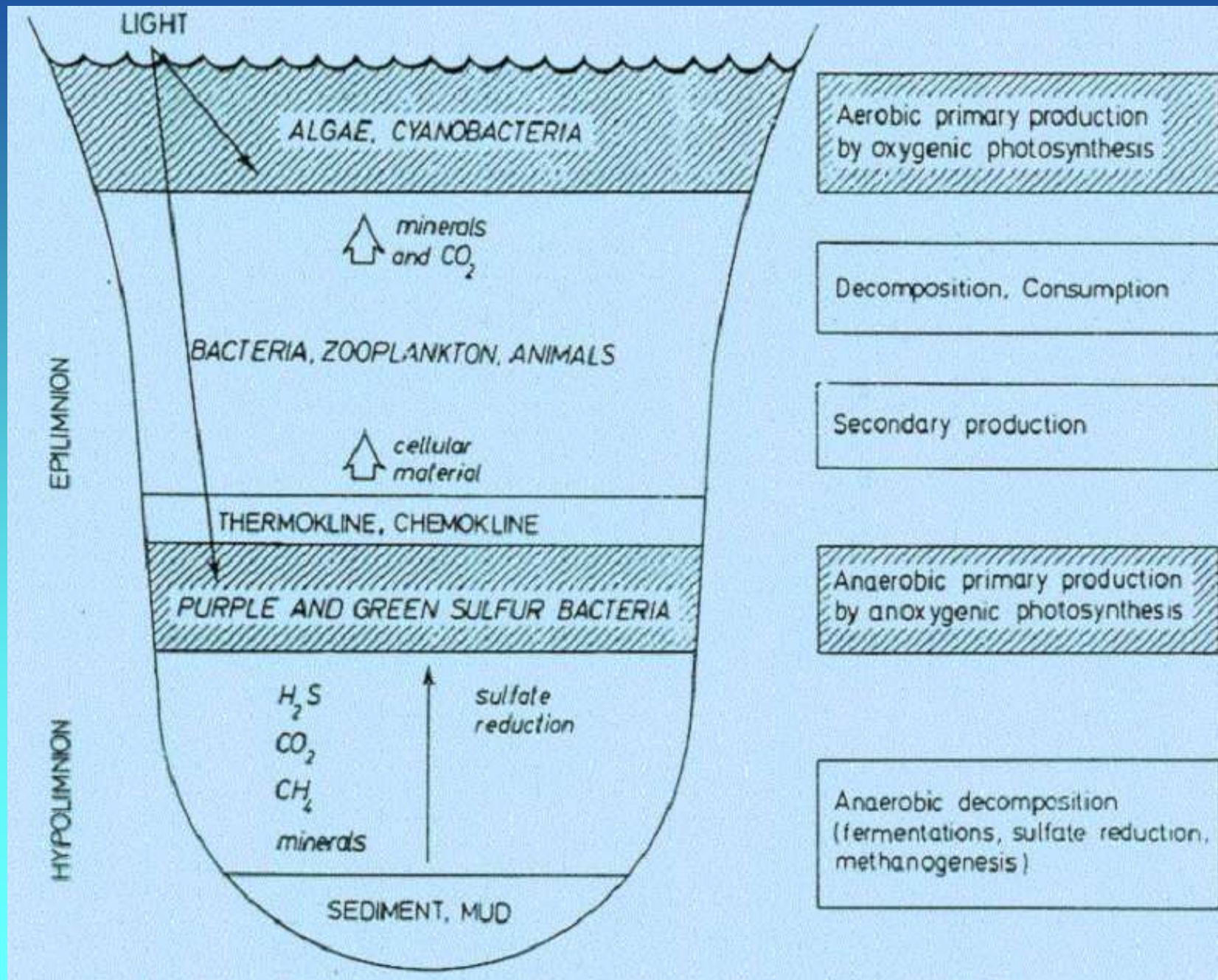


Meromixie – haloklina:

(brakické) laguny – pobřežní jezera v ústí řek

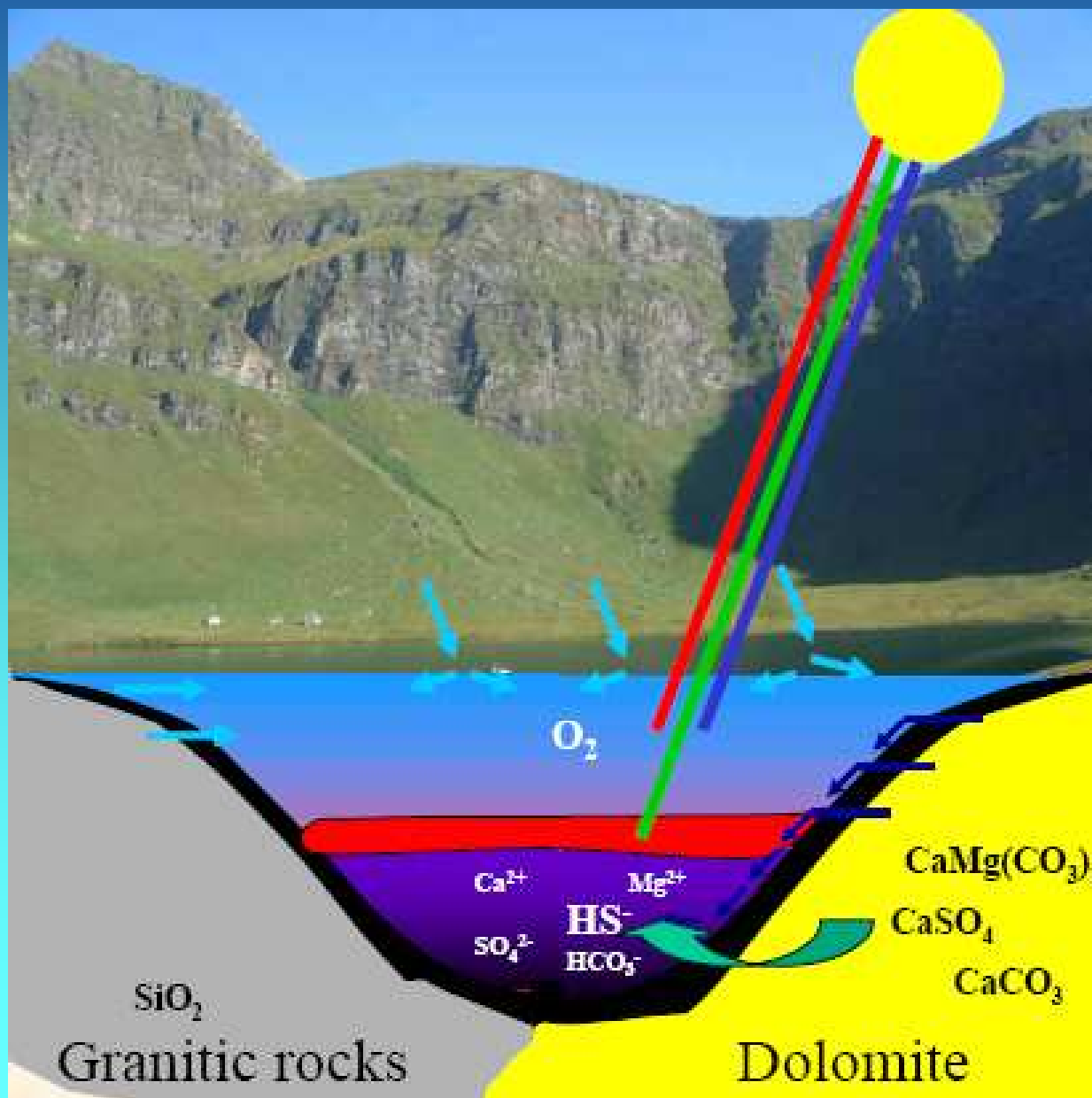


Meromixie – chemoklina:

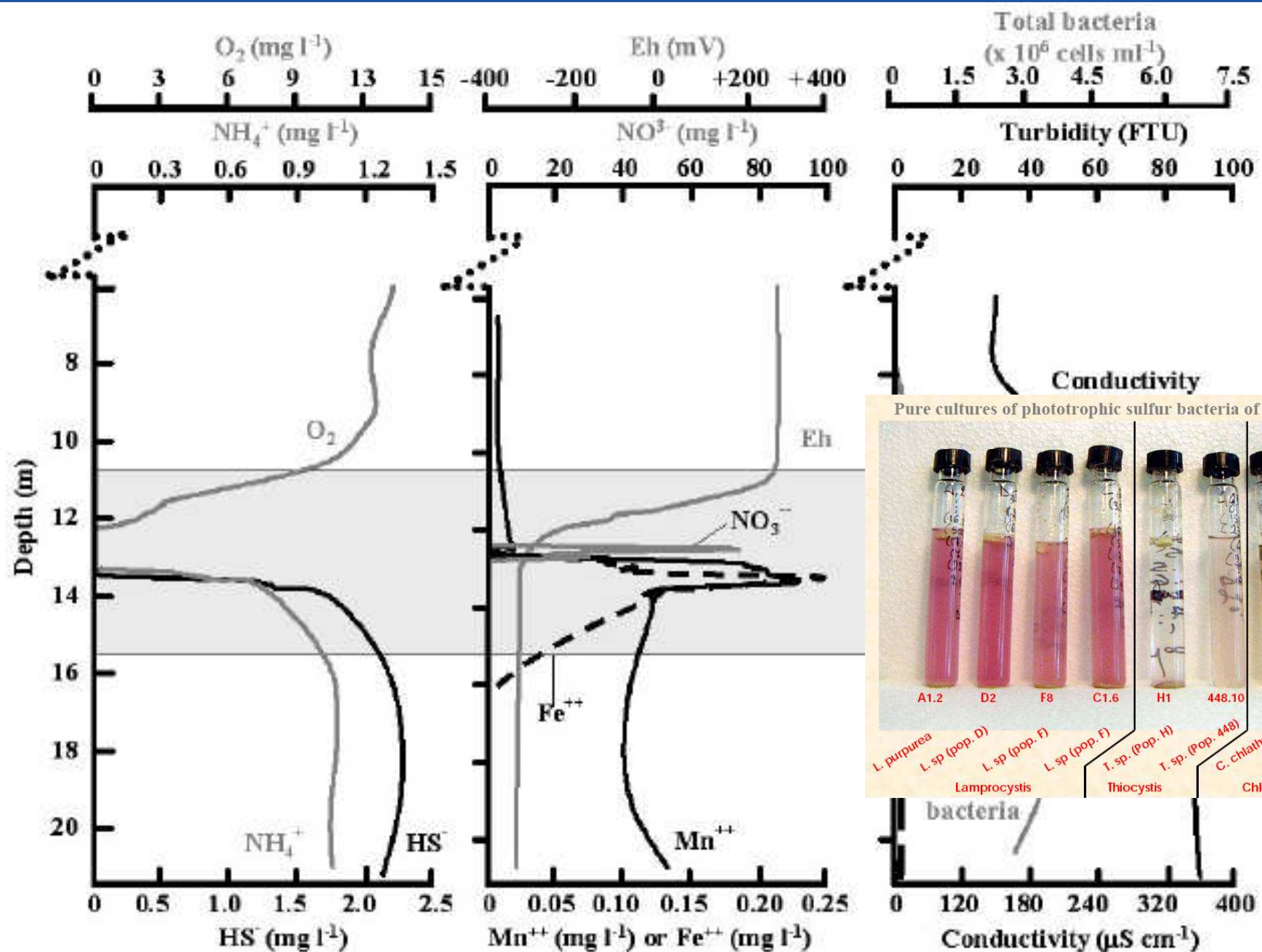


Meromixie – chemoklina:

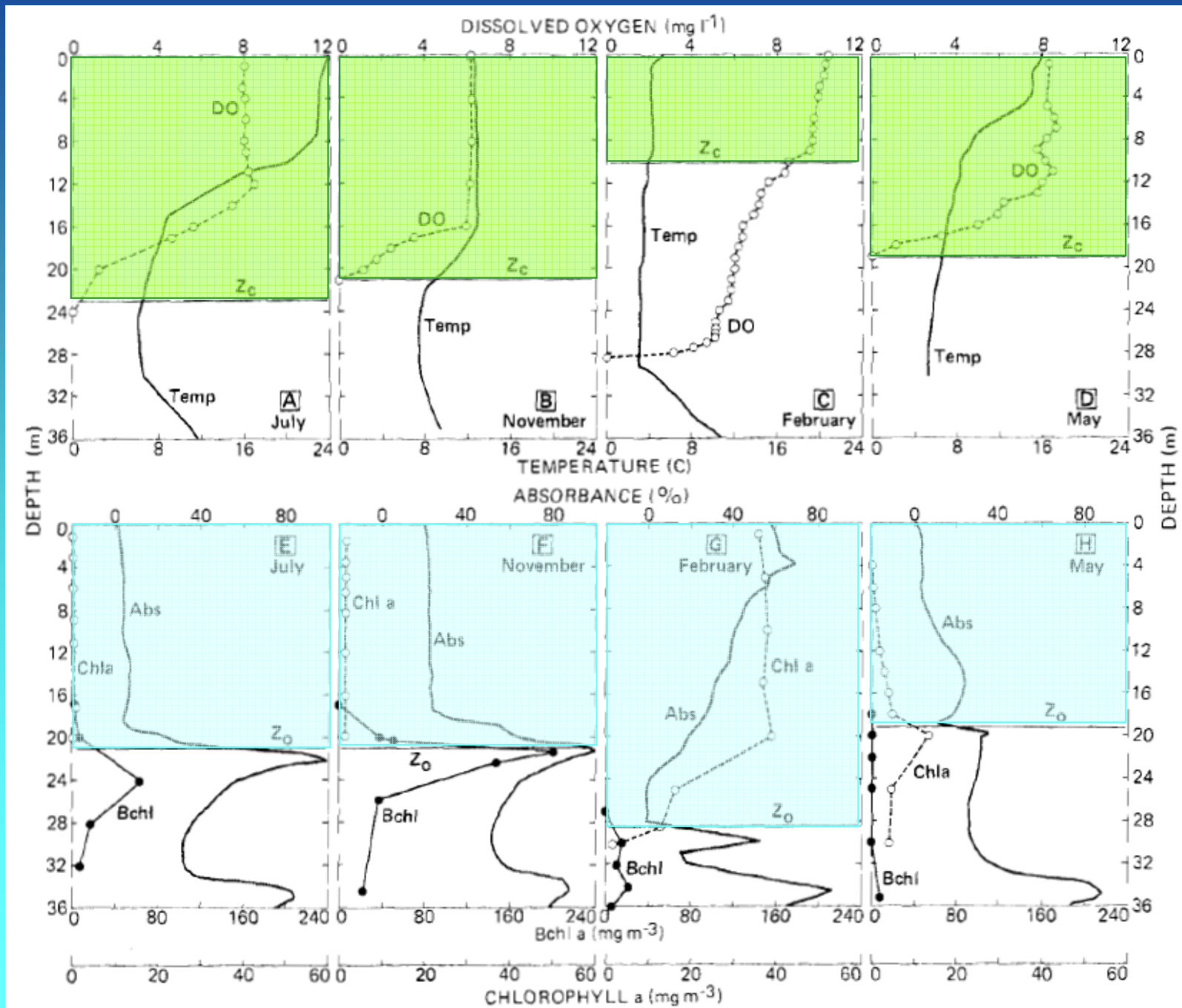
Krenogenní meromiktické jezero – Lago Cadagno, Alpy



Meromixie – chemoklina: Lago Cadagno, Alpy



Meromixie – sezónní: Big Soda Lake, Nevada



Atelomixie = denní „sekundární epilimnion“

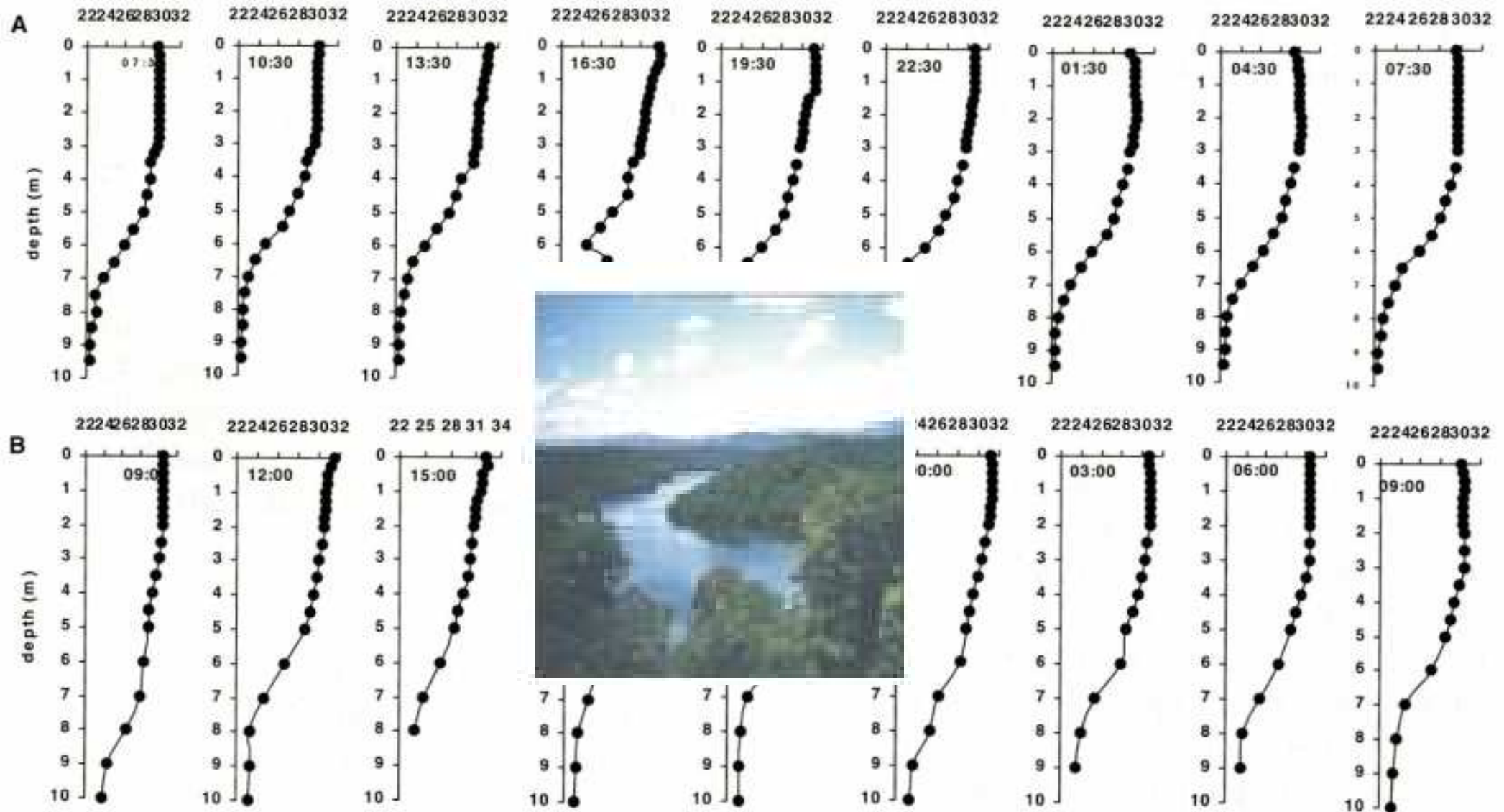


Fig. 1. Diurnal temperature variation in Lake Carioca, south-east Brazil on (A) 11/12 January 1999, and (B) 17/18 February 2000.

Atelomixie = denní „sekundární epilimnion“

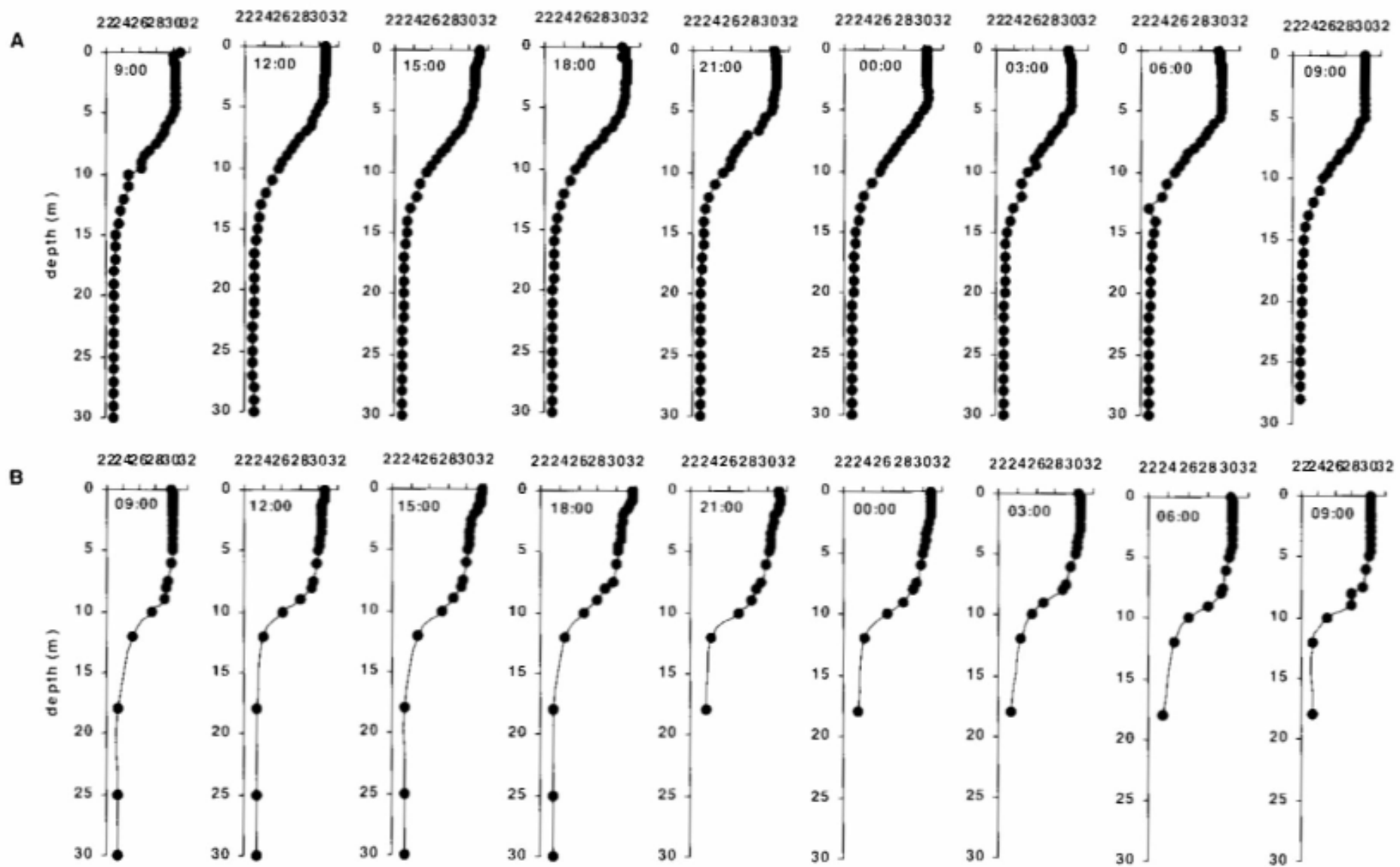
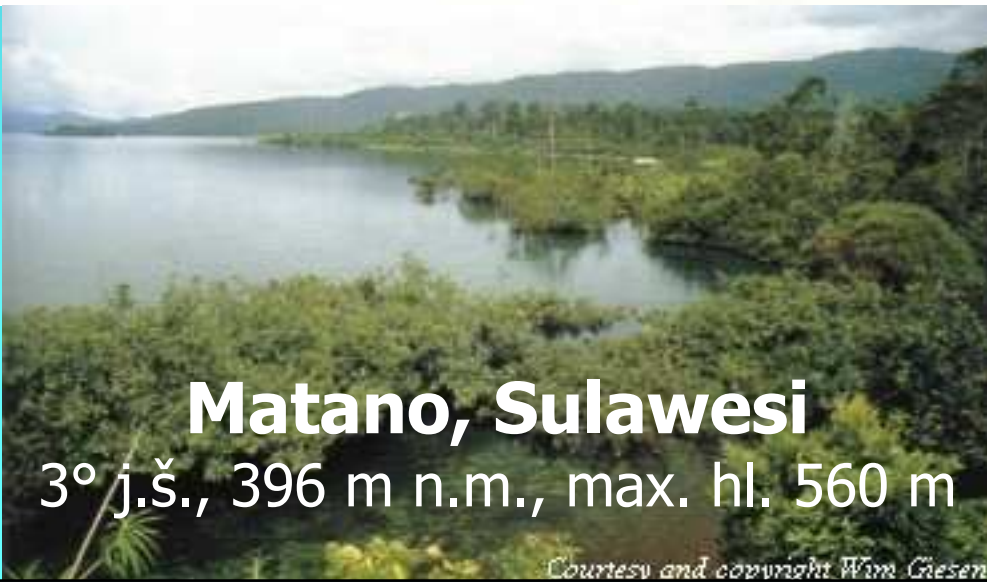
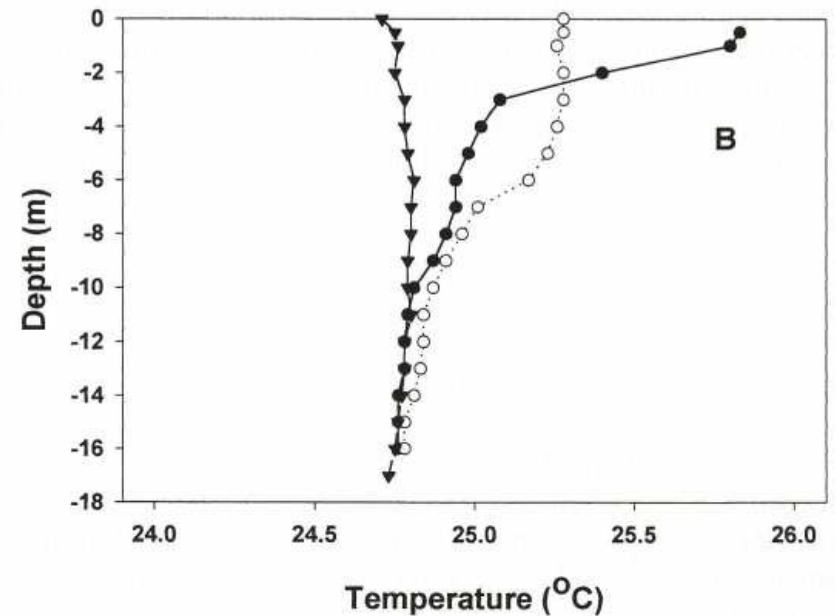
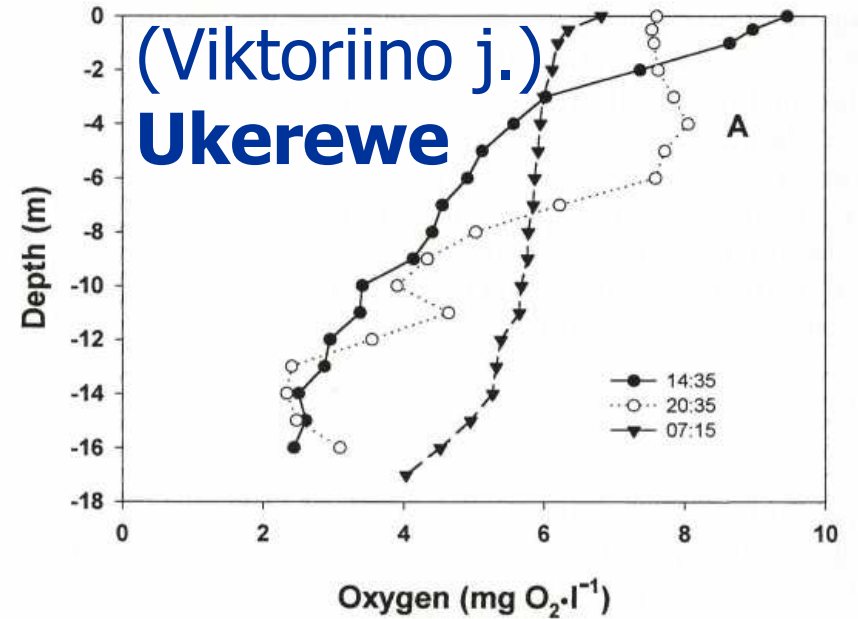
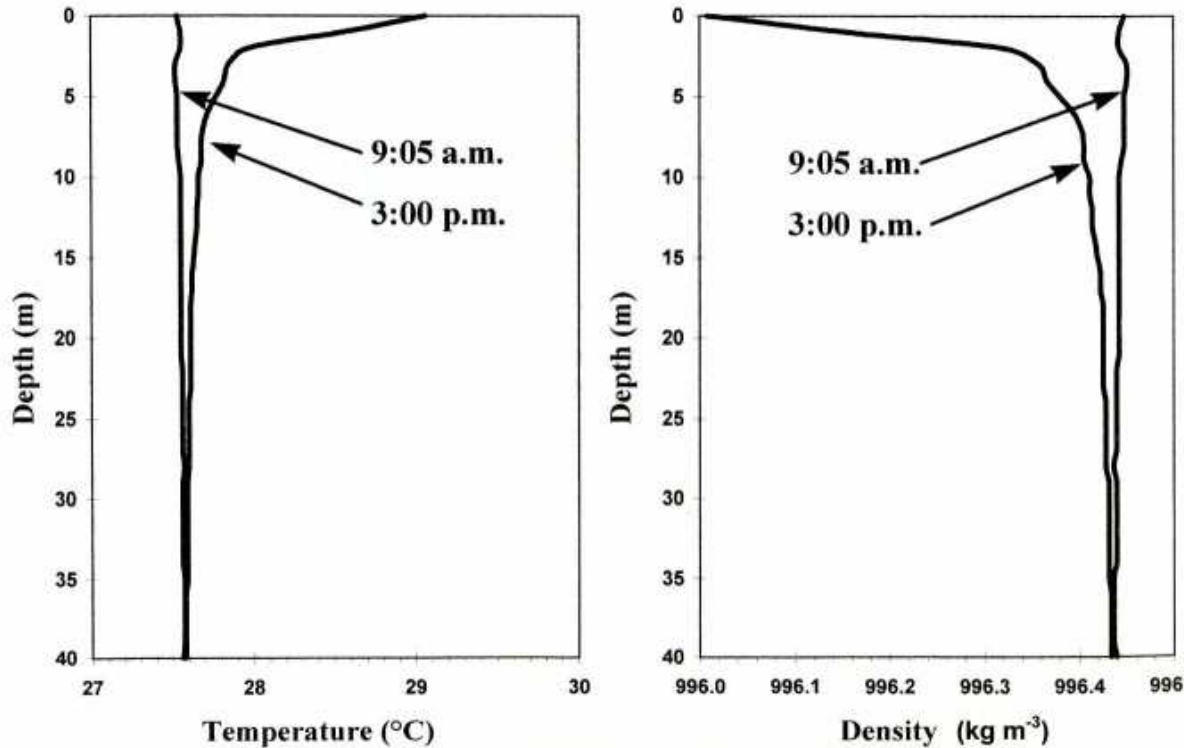


Fig. 2. Diurnal temperature variation in Lake Dom Helvécio, south-east Brazil on (A) 15/16 January 1999, and (B) 15/16 February 2000.

Atelomixie je běžná, zřejmě nejen v tropech?



Matano, Sulawesi

3° j.š., 396 m n.m., max. hl. 560 m

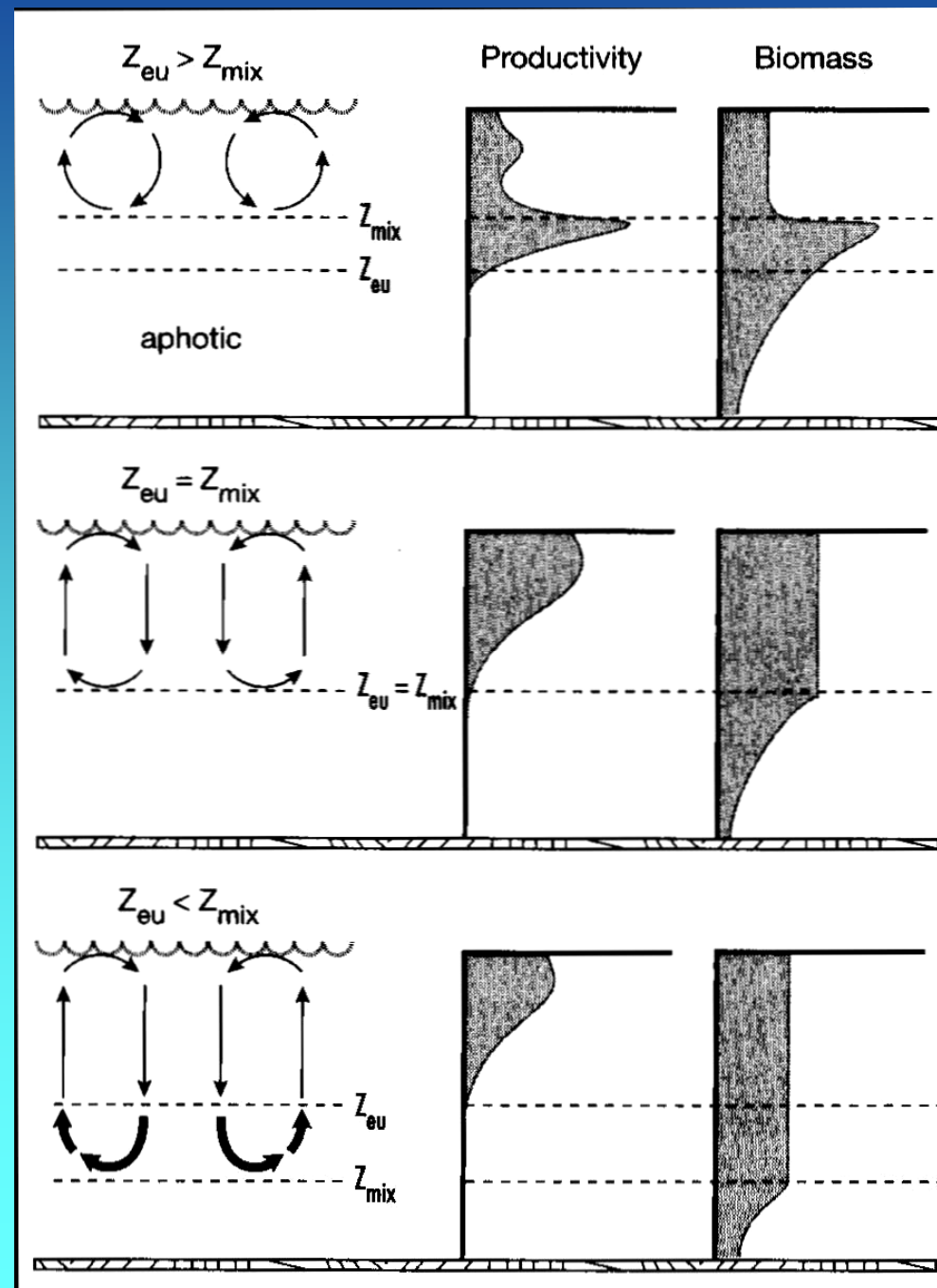
Courtesy and copyright Wim Giesen

Hluboké homotermní jezero

míchaná vrstva až 560 m!
eufotická vrstva do 40 m

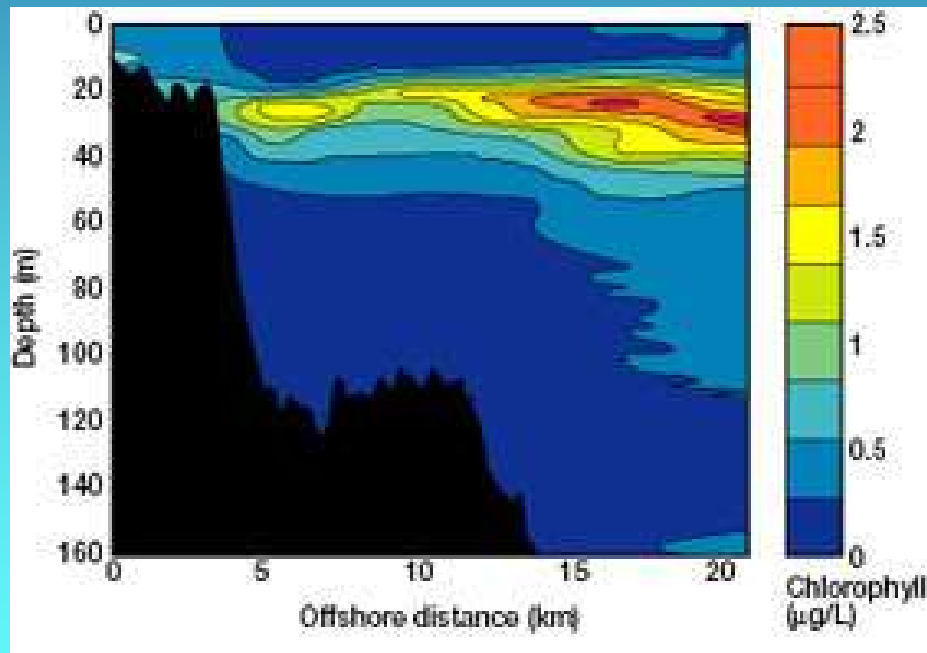
$$Z_{eu} / Z_m = 0,07$$

primární produkce
zanedbatelná ($< 10 \text{ b.ml}^{-1}$)



Stratifikace a míchání spoluurčují produkci jezer

DCM – deep chlorophyll maximum



The Great Lakes, Superior

